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THE

UNIVERSAL ELECTRICAL DIRECTORY

1901 Edition

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ELECTRICAL ENGINEERING SCHEMES BEFORE PARLIAMENT.

DURING the past month or so our columns have borne evidence to the fact that many matters of very great moment for the electrical engineering industries of this country have been threshed out before the Parliamentary Committees at Westminster.

The large number of measures which have engaged their attention have elicited much evidence of an extremely interesting nature, and while the necessity for placing it upon record in the columns of the ELECTRICAL REVIEW has naturally led to the exclusion, until a more convenient season, of many articles of practical importance, we think that our readers will have found these committee proceedings of such immediate profit as to, in a great measure, atone for the sin of monopolising such a large amount of space.

The continued success of the large power distribution schemes, which are now making their way step by step unobtrusively through the Houses of Parliament, is a matter for considerable gratification. The passage of the monorail electric express scheme through Committee produced great volumes of testimony for and against, and it cannot be said that the ultimate decision in regard to it was unsatisfactory. In a very short time the Bill will have received all the requisite legislative sanction, and the Behr system will be on a fair way for practical trial on an important scale.

Everyone is alive to the pressing need for the fullest possible inquiry to be instituted into the whole problem of increasing travelling facilities in London and other great cities, and the facts which have been collected by the Committee which has examined into the question of underground electric railways, will form an exhaustive storehouse of information which will prove invaluable to all who, whether from the point of view of electrical traction progress, or from the public good standpoint, are anxious to help in the provision of up-to-date means of transport on the best lines. As to the "electrification" of the Metropolitan and District railways, we have become so wearied with hearing about this, that, and the other, that was going to be done, but hasn't come off, that we incline to reticence as to the present phase, which finds the two companies practically at loggerheads as to whether the Yerkes combination-system-of-everything-that-is-good-in-America, or the Ganz system, is the right one to adopt. It certainly comes as refreshing news to gather from the Parliamentary Committee's proceedings that in passing the preamble of the District Company's Bill it has added a proviso, that in the event of the two companies failing to come to an agreement on the point within one month the Board of Trade shall appoint a special tribunal to decide the question.

Those of us who perused the report of evidence given before the Royal Commission, which sat a few years ago to inquire into the nuisance caused on the underground, well remember that it was recommended that if the necessary

betterment of the line were not undertaken—and electric traction was emphatically stated to be the only means of effecting substantial improvement—within a period of three years, the railway should be shut down. Even so strong a recommendation as that did not serve to dissolve the host of obstacles which have seemed to perpetually bestrew the path of the companies, and have led to the unconscionable delays of the past few years. The railway companies have themselves been large losers financially, and the Central London Railway has been considerably assisted, by their failure to act, but in addition, there is the more important matter of the public inconvenience which results from the continuation of the old state of things for so long. We trust that the contemplated action of the Board of Trade will lead to something a little more favourable to progress.

We need not here dwell upon the scores of useful electric lighting and tramway schemes which have been and are now being brought up. They are pretty familiar to our readers, and the hampering restrictions in regard to electrolysis, which some eminent professors wish to see inserted in tramway measures for the better protection of gas and water interests, we have dwelt upon at length on several occasions during recent months. We hail with cordial satisfaction the success which the electrical traction industry scored when a week or so ago the real facts of the case were placed before Committee in a practical way by practical men. The Board of Trade 1894 regulations are considered to afford ample protection if efficiently carried out. Of course, if it is true as Sir W. H. Preece says—and we see no reason to doubt his word on the point—that the staff of Board of Trade inspectors employed is inadequate to keep tramway authorities up to a full sense of their responsibilities, it rests with the Board to rectify this state of things. We cannot conceive that any argument about the inconvenience of a larger staff will hold water in the absence of proper compliance with the regulations. To order that regulations shall be complied with, and to adopt insufficient means for checking those who fail in such compliance, is the weakest of all positions to assume. We, however, incline to the belief that electric tramway systems are not offenders to any great extent, and we opine that many a tramway engineer would be prepared to come forward and certify that everything in his case is precisely as it should be. But these efficient cases do not in any way excuse the Board of Trade for permitting non-compliance.

Occasion does not require us to dilate further upon Parliamentary proposals at the present moment, but in the foregoing remarks we have endeavoured to touch very briefly upon a few of the more interesting points which have already been raised during the 1901 sittings of Parliamentary Committees.

Clearly, year by year, the attention of Parliament is being taken up more and more with electrical schemes as the great industry unfolds itself, and the broader spirit in which matters appertaining to the full development of electrical engineering are regarded is distinctly encouraging. It will grow broader still as progress succeeds progress.

ELECTRIC TRACTION AND ELECTROLYSIS.

One of our monthly contemporaries lately took us to task because of our recent articles on the action of certain Past-Presidents of the Institution of Electrical Engineers in advocating the interests of gas and water companies. We are told that science can never be advanced by a concealment of the truth, and that it is a mistake to attempt to muzzle those who are stating their honest convictions on the importance of electrolytic action on pipes by return currents from tramway rails.

We are told that we have gone out of our way to make a personal attack on the gentlemen in question, and that we have been attempting to advance the pecuniary interests of a section of the electrical engineering industry, rather than to forward electrical knowledge. We fear that the journal in question is not well informed as to the facts of the case.

We are quite at one with our contemporary in desiring the advancement of the application of science to electrical engineering ; we only differ in our ideas as to what actually constitutes science. We object to the contention that persons engaged in teaching in technical colleges are likely to form more correct views on the subject of applied science than engineers who are actually engaged on practical work, and who have the results of daily experience to guide them. We are almost weary of the discussion as to the relative merits of these two classes of men, but we have been driven to recognise that, however able scientific men may be, they too often utterly fail when they attempt to apply their knowledge to the conditions of practice.

Take the case in point. The evidence to which we objected was based on several statements boldly put forth as scientific truths. It was assumed, for example, that the whole earth was an electrolyte, and that when a given current passed through it from a rail to a pipe, it caused the eating away of a perfectly definite amount of metal ; but it has been shown by M. Claude, a practical tramway engineer, that what may be true of the electrolytic cell in the laboratory is not true under actual tramway conditions—that, in fact, the earth is not an electrolyte in the ordinary sense, but that it largely acts as a conductor, and conducts without electrolysis.

Instead of the theoretical electro-chemical amount of metal being eaten away, M. Claude shows that the actual consumption may be a very small proportion of this. One of his experiments gave 4 per cent., another gave 3½ per cent., and so on.

Another of the so-called scientific bases was the assumption that all the return current went through the gas or water pipes. This we know to be in accordance neither with scientific nor with practical knowledge.

A further assumption was that the average current taken by tramcars was 40 amperes per car, or three or four times as high as it actually is in practice. Calculations of the amount of the eating away of pipes were based on this average current, although on cross-examination the author of this extraordinary piece of scientific evidence admitted that the figure was only taken hap-hazard and for the purpose of calculation, and that he really did not know what the average current was.

The Commons' Committee on the Bexley Tramway Bill called the late Sir Courtenay Boyle and Mr. Trotter, and learned from them that where the Board of Trade Regulations were complied with there was no evidence of even incipient damage from this cause. The

gas and water companies had exerted their utmost efforts to find some actual evidence that electrolysis was doing actual damage to their pipes and had entirely failed. It never appears to have occurred to their advisers that the complete absence of evidence of damage showed there must be something wrong with their witnesses' so-called scientific laws. If these persons had been engaged in practical work they could not have failed, on weighing the facts, to see that there must somewhere be a weak link in their chain of evidence.

The advance of knowledge in this matter has been considerable, but it has not come from the side that claims to be scientific. It is a difficult matter to explain why the real advances in the application of science to practice are almost always made by persons who make no claim whatever to be considered scientific men.

In the Bexley case the Commons' Committee decided against the demand of the gas and water companies, and declined to insert a clause making the Bexley authorities responsible for damage to their pipes, except so far as they are responsible under the existing law. This is right and sensible, seeing not only that there is no evidence of damage by electrolysis, when the Board of Trade regulations are complied with, but that neither the companies nor anyone else can tell what are the causes of eating-up of pipes under ordinary circumstances; how much is due to ordinary chemical action by the soil; how much to impure or faulty castings or to "earth currents," or currents due to other causes than the tramways. It is well known that pipes in some soils last indefinitely, and in others only a few years—where there is no question of electrical action. To discriminate is therefore impossible. The position of a tramway company or small local authority would be no enviable one if a powerful gas company thought fit to attempt to get compensation for alleged corrosion of its pipes by tramway currents. Such a claim based on "scientific" evidence of the sort we have drawn attention to, and backed up by the special clause for which the struggle has been made, would render the tramway position an intolerable one—whatever the issue.

The fight was renewed before Sir John Kennaway's Select Committee on the London United Tramways Extension Bill, and fortunately with the same result as before the Commons' Committee on the Bexley Bill. The proceedings were reported by us last week.

This week saw an attempt made to again pursue the matter before the Lords' Committee on the Bexley Bill, but it is more than satisfactory to learn that this was not successful; no reopening of the question by counsel or by witnesses was allowed, and the offensive clause will not be inserted in the Bill.

It seems to us that the work of the Special Committee might as well have never been carried out if its recommendations are to be contested every time a tramway Bill is promoted. That Committee sitting under Lord Cross heard all persons and parties interested, and left the matter in the hands of the Board of Trade—which, it must not be forgotten, has full power to alter or amend its regulations at any time if it finds it necessary to do so. Seeing what ample protection is now obtained under the existing law, and under the existing regulations, and how certain it is that the Board of Trade will give further protection if any reasonable cause can be shown, it is certainly unreasonable and unjust that the electrical industry should be taxed, as is at present the case, in order to stave off the rapacious gas and water companies.

Electricity in a Preserves Factory.—The large new factory of Mr. Wm. P. Hartley at Green Walk, Bermondsey, which covers an area of about 2 acres, is fitted throughout with a very complete electrical installation for lighting and power. The generating plant consists of two horizontal slow-speed engines, made by the Burnley Ironworks Company, driving, by means of ropes, two A 85 Schuckert multipolar dynamos, each having an output of 69 KW. at 220 volts. Space is provided in the engine room for additional plant when extensions become necessary. The main switchboard is of white marble, and contains two dynamo panels fitted with ammeter, voltmeter, D.P. main switch, S.P. main fuse, automatic cut-out, and shunt resistance for each machine, one spare dynamo panel for future machine, and two circuit panels for the various lighting and power circuits. The circuits are provided with throw-over switches, enabling them to be fed by either dynamo as required. The lighting of the factory is effected by some 700 incandescent lamps of 16 C.P. and 26 Thomson-Houston arc lamps of enclosed type. The wiring is carried out on the distribution system, each floor having its own distributing switch and fuseboard. The wires are, for the most part, run in wood casing, but in the boiling rooms and other portions where steam and acid vapour are present, they are protected by insulated conduits. In the latter portions the fittings and distributing board cases are of water-tight pattern. The electric lifts, of which there are five, made by Messrs. Waygood & Co., are of 1 ton capacity each, the motors being of 17 H.P. Two Schuckert motors of 10 H.P. each are used for driving box-making and other machines. The ventilation of the boiling and similar departments is provided for by means of 17 electric fans by Messrs. Matthews & Yates, Limited, varying from 18 in. to 30 in. diameter, the motors being of ½ H.P. to 1½ H.P. The contractors for the work and makers of the switchboard were Messrs. Simpson Bros., of Hapton, Burnley, and the consulting engineer was Mr. Reginald J. Wallis-Jones, of Westminster.

Water-power in Norway.—In view of the large number of schemes now coming before the public and before financial people for the development of water-power schemes, it may be of interest to mention that of the Glommen Traeslibi Company, of Christiania, who are at present engaged in carrying out an enormous electrical power transmission plant at Askim. The company being the owner of various waterfalls on the Glommen, a river flowing through Norway from north to south, is utilising the largest of these near Askim. The plant is designed for about 45,000 effective H.P. Their hydraulic works are nearly complete for their entire outfit, but the power station is equipped at present for 12,000 H.P., and will be increased later on for the maximum output mentioned. On this part of the plant a large staff of engineers and workmen—about 1,000—have been busy for the last 18 months, and it is expected that the plant will be completed by the middle of next year. The turbine station is connected direct with the railway station at Askim by a new full-size goods railway. The power house will be equipped with three generators, each consisting of one Francis turbine with vertical axle, direct-coupled to a three-phase dynamo for an output of 2,000 KW. at 5,000 volts. To each generator there belong three three-phase transformers with an output of 700 KW. each to transform the generator current to 20,000 volts. For extensions of the power station special 5,000-H.P. sets are proposed. The arrangement of the transmission line which is to convey electric energy to Christiania, the capital of Norway, and to the outlying districts of that city, are so far advanced that in autumn next year current can be delivered to the consumer. The negotiations with all consumers who come into consideration have already been commenced. From the above installation not only the entire city of Christiania and its neighbourhood will be fully supplied with electric energy for lighting and power purposes, but also all new industrial enterprises which within the next decade will be erected within a radius of 50 miles of the power station can be supplied cheaply with electric energy. The carrying out of the entire installation has been entrusted to the well-known Schuckert Company, of Nuremberg.

D

GLASGOW INTERNATIONAL EXHIBITION, 1901.

II.

Seeing that the main feature of the engineering department of the Exhibition is the electrical transmission of power, we may appropriately commence our review of the exhibits by a description of the generating plant laid down for that purpose.

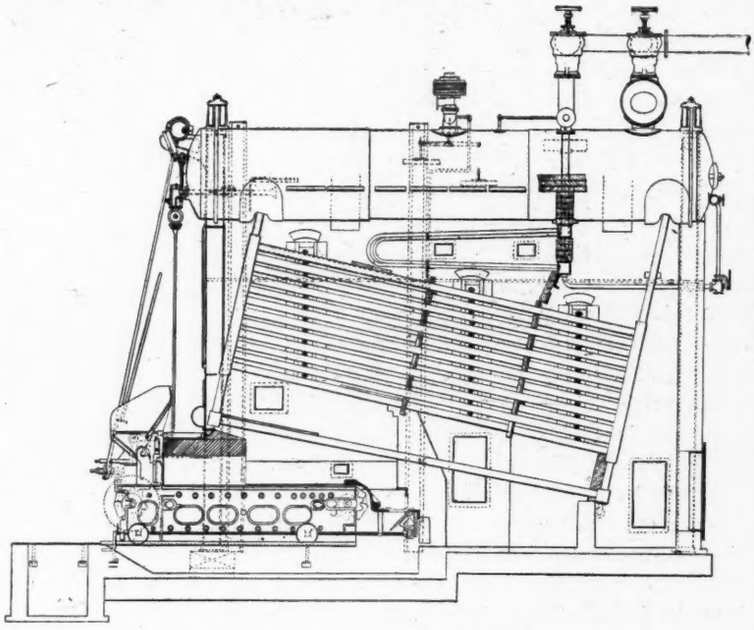
The boiler house contains a very representative collection of British boilers, embracing land and marine water-tube, dryback, and Lancashire types. At the outer corner is the exhibit of Messrs. Babcock and Wilcox, consisting of one marine and two land boilers, each nominally of 1,000 I.H.P.

As will be seen from the illustration, the marine boiler differs in a marked degree from the type to which electrical engineers are more accustomed; the steam drum lies transversely across the front of the boiler, and the inclined tubes slope *upwards* from the front to the back of the boiler, the water circulation being completed by means of a number of nearly horizontal tubes from the back headers to the steam drum, which they enter above the water-level.

The arrangement is exceedingly compact, and every part is accessible; the tubes are straight, and any one of them can be replaced without disturbing the rest. The hot gases pass three times through the lower nest of tubes, with the result that they pass into the flues at a moderate temperature. There are no screwed joints, the tubes being expanded in place. The normal working pressure is 200 lbs. per square inch. Tests by the Admiralty on these boilers have shown an evaporation of over 12 lbs. of water from and at 212° F. per lb. of combustible.

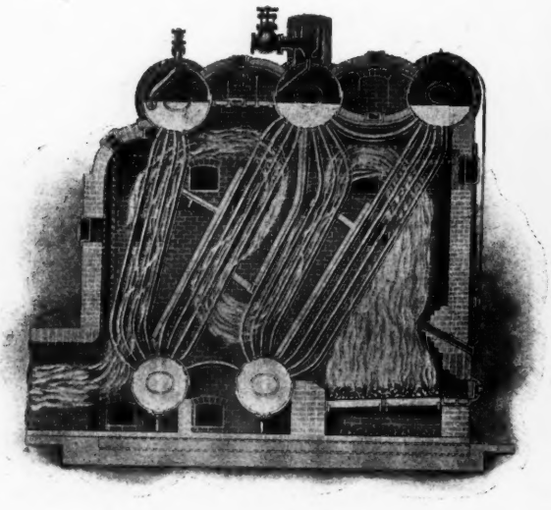
The two land boilers exhibited by Messrs. Babcock and Wilcox are fitted with their patent Scotch furnace, as shown by the section herewith—an additional row of tubes being fixed some distance below the main battery, so as to form an internal chamber. Each boiler is composed of 18 sections of 12 tubes each, besides the extra row, and has a heating surface of 5,137 sq. ft. The tubes are 4 in. in diameter, and 18 f long, connected by vertical headers with steam and water drums 4 ft. in diameter and 23 ft. long. The latter are again connected by a steam chest 20 in. in diameter and 8 ft. 6 in. long.

Each boiler is also fitted with the company's patent superheater, capable of imparting 100° to 120° F. superheat to the steam, and their chain grate stoker; these are clearly shown in the cross-section.

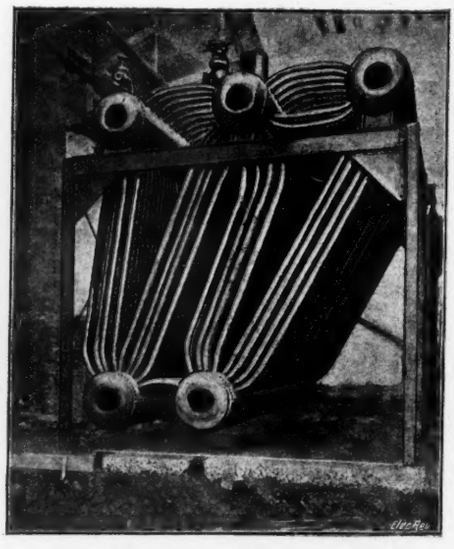


Cross Section of Babcock & Wilcox Boiler, with Scotch Furnace, Superheater, and Chain Grate Stoker.

All these boilers discharge their products of combustion into two vertical steel flues; the same arrangement is used for the other boilers exhibited, and has caused some trouble, as the height of the chimneys is insufficient to produce the necessary draught. Cockburn spring safety and stop valves and Turnbull's dead weight safeties are used, with MacFarlane's "explosion" valve to guard against accidents.



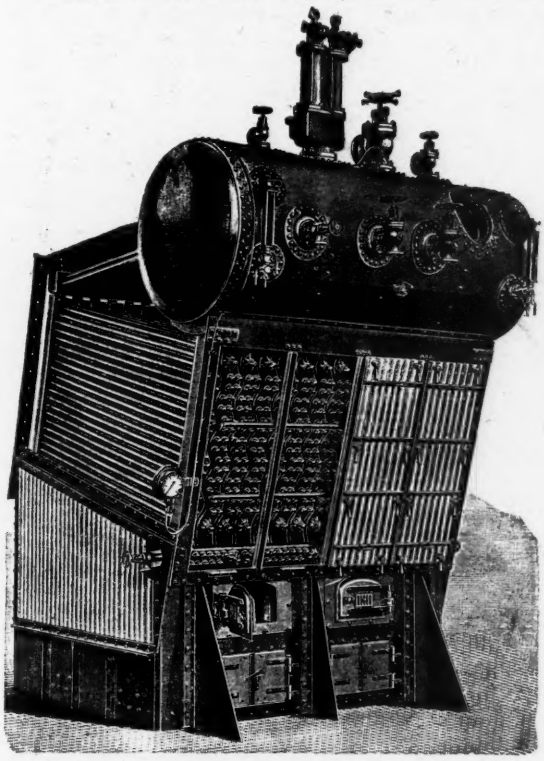
Cross Section of Stirling Boiler.



Stirling Boiler in Course of Erection.

The next exhibit is that of the Stirling Boiler Company, Limited, and consists of two of their water-tube boilers, of the type shown in the accompanying illustrations. One of these is fired with producer gas, the other with coal, by means of Vicars mechanical stokers. We understand that trials of the relative efficiencies of the gas and coal firing are to be made during the current month, the results of which will be awaited with great interest. The construction of

the boiler is clearly shown by the section, which also indicates the course followed by the hot gases through the tubes. It is especially noticeable that the gases travel to a great extent *along* the tubes, affording full opportunity for the transfer of heat to them. The back section of the boiler is isolated from the general circulation and receives the feed water, acting, therefore, as an economiser and purifier. Free circulation is provided for by the horizontal tubes con-



Babcock & Wilcox Boiler. (Marine type.)

necting the steam and water drums. The bottom drums are suspended from the tubes, giving perfect freedom for expansion; any tube can be replaced without interfering with others, and the joint is made by expanding. The floor space occupied by this type of boiler is exceptionally small, owing to the steep inclination of the tubes—the height being somewhat increased for the same reason. Each of the boilers exhibited has a heating surface of 3,250 sq. ft., and will evaporate 16,250 lbs. of water per hour.

ON POLYPHASE GENERATING AND SUB-STATION PLANT FOR ELECTRIC TRACTION.

By H. S. MEYER, Rugby.

In your issues of June 7th and 14th, Mr. A. C. Eborall gives his views on a short article by Mr. Hobart concerning the frequency to be used in tramway installations. Although siding with him on the whole against Mr. Hobart, there are a few points which I should like to mention.

First of all, I do not consider damping devices inherent to rotary converters or their generators; on the contrary, I venture to say that under the conditions assumed by Mr. Eborall as a standard lay out for traction schemes, if the rotaries are designed and installed with the necessary forethought, and if the prime movers have actually a speed regulation within the limits given, at the same time being provided with governors with suitable dashpots, there should be no necessity for copper bridges or squirrel cage windings. The rotary itself should have (1) The magnet frame of cast-iron, a material with low magnetic resistance, so as to enable the flux to follow small changes in voltage; (2) Solid steel poles should be used, which in themselves act as a screen against any pulsating shift of flux; (3) The pole arc should be long, about 80 per cent. of the pole pitch.

Together with these points in design, the plant should be so arranged as to (1) Avoid large resistance drop between generators and rotaries; (2) Where several rotaries are fed from one station, to use the same primary line, but individual transformers; (3) To ensure good end play to keep the commutators in a good mechanical condition.

For rotaries designed so as to be operated without special damping devices, a large momentum of the rotating parts as advocated by Mr. Hobart may increase their stability as the ratio of the period of oscillation to the natural period of the revolving masses may get more favourable. In fact, one case is known to the writer where an additional fly-wheel on the rotary has cured hunting.*

In the second part of Mr. Eborall's article, I take exception to the comparison of efficiencies of rotary converters and motor-generators. The figures given by Mr. Eborall surely compare a very poor motor-generator set with a very good rotary converter, otherwise no such differences in efficiences could be obtained, especially as all the losses in transformers, damping coils, and auxiliary reactances are included in the rotary converter efficiency, while the synchronous motor has no such devices.

A standard 500 kw. direct current generator should have a full load efficiency of at least 94 per cent., and a half load efficiency of 91 per cent., the same holding good for a synchronous motor. The different efficiencies would then be as follows:—

Efficiency.	Rotary converter (Eborall).	Motor-generator. (Corrected.)	(Eborall).
Full load	92	89	87
Half load	87.5	83	79

This would only show a gain for the rotary converter of 3 per cent. at full load, and 4·5 per cent. at half load. Similar results are given by Mr. H. E. Stott in a recent paper read before the A.I.E.E., in which he describes the Buffalo sub-station, where both classes of machinery are installed. He gives as the gain in efficiency with a 200-kw. rotary converter and transformers against motor-generators of the same capacity fed directly from high voltage lines, 3·27 per cent. at full load; 4·89 per cent. at half load. These rotaries have no damping devices, and therefore the figures would be still lower if such losses were included. To put these losses down at $\frac{1}{2}$ to $\frac{3}{4}$ per cent. seems rather too low, at least where open slots, copper bridges undercutting the pole pieces, and a small gap are used, being nearer to 1 or $1\frac{1}{2}$ per cent. Mr. Stott gives a saving of 19 per cent. in investment for the rotary converter equipment against the motor-generator, which also agrees with the writer's own experience, so long as those machines supply a traction system where no fine adjustment of voltage is necessary and where compounding is done by phase control.

One point in favour of Mr. Hobart's scheme which is not given sufficient prominence by Mr. Eborall, is the greater ease of synchronising at a low frequency. If, for example, the frequency should only be one-third, the beating of the synchronising lamps will only be one-third as frequent, and an error of, say, $\frac{1}{10}$ second in closing the switch will allow the machines to get out of phase by an angle only one-third as great as with the same speed variation and three times the frequency.

As regards the allowable deviation from constant angular velocity, I have found that the different engine and dynamo builders calculate the necessary fly-wheel effect in entirely different ways, and therefore large discrepancies as given by Mr. Eborall may arise.

I should like to say a few words regarding this matter, and also give a handy way of calculating the necessary fly-

* Furthermore, I do not agree with Mr. Eborall as to pressure tests for armature insulation. I consider the values given for 8,000 and 10,000 volts as too low. They should be tested with at least double the normal rated voltage, especially where underground cables are used. This is also in accordance with the rules laid down by the American Institute of Electrical Engineers. As an example, I may state the guaranteed tests for the Manhattan generators, which deliver current at 11,000 volts:—

These are 25,000 volts for 30 min.;
or 30,000 volts for 1 min.;
or 35,000 volts for 1 sec.;

Besides, the temperature should be stated at which the flashing tests are to be made, since the strength of insulation when hot is generally much less than when cold. The temperature corresponding to normal load should be chosen.

wheel effect. Mr. Hobart advocates 2½ per cent., Mr. Eborall 2 per cent., while the latest practice in the States goes up to 3 per cent. variation between a mean constant velocity and a maximum or minimum. The variation allowable will depend on the amount of cross current allowable; for example, if we assume an alternator to have a short circuited current equal to three times full load current, then, if full load current is represented by 1, we may say the impedance $= \frac{E}{3}$. The maximum difference between any two sine waves of E.M.F. of amplitude E, and displaced by an angle a, $= 2\ E \sin \frac{a}{2}$. This resultant E.M.F. is short circuited through the impedance of two generators in series, hence the resultant cross current will be

$$\frac{2\ E \sin \frac{a}{2}}{2 \times \frac{E}{3}} = 3 \sin \frac{a}{2}.$$

We say this current shall not exceed 10 per cent. of the full load current, then we get as upper limit

$$\cdot 1 = 3 \sin \frac{a}{2},$$

$$\sin a/2 = \cdot 0313,$$

$$a/2 = 2°,$$

where $a/2$ is the angle between each wave and the mean. If we allow 15 per cent. of the full load current as the maximum cross current, the deviation from constant angular velocity may be 3° from mean to maximum or minimum, or 6 per cent. between maximum and minimum. According to the author's experience this latter figure gives generally satisfactory results with a frequency of 25 ~ if copper bridges or other damping devices are used, while 1·5° to 2° should be asked for without such devices.

In a generator of $2n$ poles there are generated $n \times 360$ electrical degrees per revolution. In a cross-compound engine each reciprocating part is started and stopped twice during each revolution, but as the cranks are displaced, this amounts to starting and stopping four times in a revolution, causing an intermittent give and take of energy. There are, therefore, four impulses, and as there are $n \times 360$ electrical degrees generated per revolution there are $\frac{n \times 360°}{4}$ per impulse.

Allowing per impulse 2·5 electrical degrees ahead, and 2·5 behind, the allowable variation in speed during ½ impulse will be

$$s = \frac{\frac{5}{n \times 360}}{2 \times N} = \frac{40}{n \times 360} = \frac{\cdot 111}{n}$$

s being the per cent. variation in speed from mean to max. or min. N = 2 (single-cylinder engine.) N = 4 (cross compound, and three-cylinder engines).

$$s = \frac{v \text{ max.} - v \text{ min.}}{v \text{ mean const.}} = \frac{v_2 - v_1}{v_0}$$

where v_0, v_1, v_2, are expressed in feet per second. The energy taken and supplied by the fly-wheel during each impulse is

$$\tfrac{1}{2} \frac{W}{g} (v_2^2 - v_1^2).$$

W = weight of fly-wheel in lbs.
g = const. of gravitation = 32.
v_2 = max. periph. speed of fly-wheel during one impulse.
v_1 = min. periph. speed of fly-wheel during one impulse.
v_2 and v_1 expressed as the mean constant periph. speed will be:

$$v_2 = v_0 + \frac{s}{2},$$

$$v_1 = v_0 - \frac{s}{2},$$

$$v_2^2 - v_1^2 = v_0^2 \times 2\ s,$$

or weight of fly-wheel equals

$$\frac{W}{2\ g} (v_0^2 \times 2\ s).$$

As this expression has to take up the unbalanced energy P_1 per impulse, we may write it $= P_1$. P_1 is found from the indicator cards and diagram of crank effort, and is generally given by the engine builders, but should be carefully checked where the data can be obtained.

The weight of fly-wheel for a given per cent. variation in speed is therefore equal to

$$W = \frac{P_1 \times 2\ g}{v_0^2 \times 2\ s} \text{ in lbs.}$$

W being reduced to the diameter at gap, to find the actual weight corresponding to diameter of gyration, W is to be taken times $\left(\frac{\text{diameter of gyration}}{\text{diameter at gap}}\right)^2$. If P is the energy per revolution in foot pounds, $\frac{P_1}{P}$ is called the unbalancing factor, which ratio engine builders often state instead of P_1.

The following is an example of the above, taking an 80-pole 1,500-KW. machine running at 90 r.p.m.:—

The unbalancing factor being given as = ·05,

s for a cross-compound engine $= \frac{\cdot 111}{40} = \cdot 00278$,

P = energy per revolution in ft. lbs.,

$$= \frac{\text{KW.} \times 33{,}000}{\cdot 746 \times \text{efficiency} \times \text{r.p.m.}},$$

$$= \frac{1{,}500 \times 33{,}000}{\cdot 746 \times 95 \times 90} = 775{,}000 \text{ ft. lbs.}$$

$P_1 = \cdot 05 \times 775{,}000 = 39{,}000$ ft. lbs.

$$W = \frac{39{,}000 \times 2 \times 32}{v_0^2 \times 2 \times \cdot 00278} = 55{,}000 \text{ lbs., about 25 tons.}$$

$v_0 = 82{\cdot}5$ ft. per second.

Diameter at gap = 17·5 ft.

This would correspond to a fly-wheel effect $W r^2$ at a diameter of gyration = diameter of gap = $25 \times 8{\cdot}75^2$ = 1,920 foot-tons.

Even though the fly-wheel is calculated in such a manner, the actual deviation in angular velocity might be somewhat different after the machines have been installed, as several factors come in which cannot be taken care of by calculation. For instance, we have assumed that the energy during each impulse will be the same, which in reality may not be the case; besides, the setting of the valves and other mechanical points have an important bearing on the results.

Therefore, careful measurements should be made when the machines are set up to obtain an accurate value for the above before reliable conclusions can be drawn as to hunting troubles. It is evident that such a small value cannot be readily measured, although a number of special apparatus are manufactured for obtaining it.

The following is a description of a simple method, devised

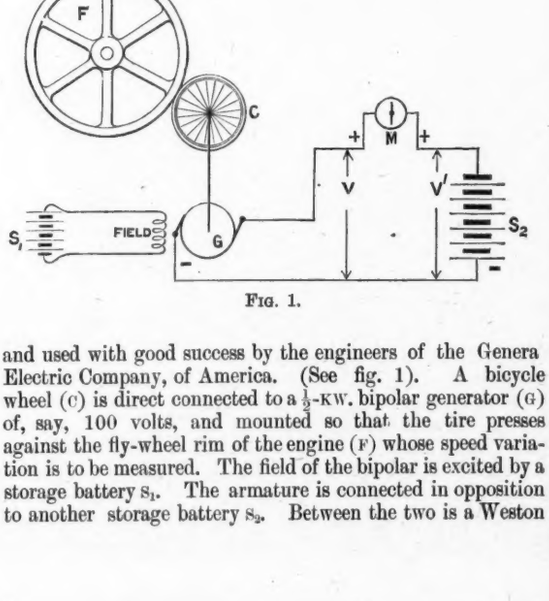


Fig. 1.

and used with good success by the engineers of the Genera Electric Company, of America. (See fig. 1). A bicycle wheel (C) is direct connected to a ½-KW. bipolar generator (G) of, say, 100 volts, and mounted so that the tire presses against the fly-wheel rim of the engine (F) whose speed variation is to be measured. The field of the bipolar is excited by a storage battery S_1. The armature is connected in opposition to another storage battery S_2. Between the two is a Weston

direct-current voltmeter (M) with a scale reading, say, 2 volts. It will be seen that when v is adjusted so as to equal v^1, any variation of v will be indicated by the voltmeter; as the value of v is proportional to the speed of the fly-wheel, it means that any variation in angular velocity will be shown by the voltmeter. The method being differential in its action is very sensitive. As the variations in angular velocity are read as the ratio between the voltmeter readings and the voltage of the dynamo, the degree of accuracy can be increased by either taking a still lower reading voltmeter, or raising the voltage of the dynamo.

As an example, I take the above given 80-pole machine direct connected to a cross-compound engine. The voltmeter showed deflections of ·2 volt, the storage battery voltage was 70 volts. The angular speed variation is consequently $= \frac{\cdot 2}{70} = \cdot 00286$ per cent., while the calculated value gave $s = \cdot 00278$ per cent.

In summing up I should like to repeat that no final conclusion regarding hunting should be drawn from engine builders' guarantees *re* speed variation of different engines, so long as it is not known how the results were arrived at, and how they will compare with actual tests.

Damping devices should only be necessary where the angular speed variation cannot be kept within the limit of 2° or less; that is, where the fly-wheel to accomplish this would get unproportionally heavy.

PARLIAMENTARY COMMITTEES.

South Lancashire Tramways Bill.

Mr. Holland's Select Committee of the House of Commons commenced the consideration of the South Lancashire Tramways Bill on 25th ult. The Bill, which has already passed the House of Lords, had for its objects the conferring of further powers on the company for the construction of tramways and street improvements and other purposes. The opponents to the Bill were the Lancashire Electric Power Company, the National Telephone Company, and the Newton-Makerfield Urban District Council.

Mr. Moon, who, with Mr. Balfour Browne and Mr. C. H. Lloyd, were counsel for the promoters, explained that last session the company obtained powers for the construction of a large number of important tramways coupling up Wigan, Bolton, Leigh, Atherton, and other places. These tramways were made in connection with other tramways which were to be worked electrically between St. Helens and the City of Liverpool, and the Manchester tramways, which extended from Swinton to Salford and Manchester, so that when the lines were constructed there would be electrical tramway communication between Liverpool and Manchester. The Bill now before the Committee followed on the powers given last session. Last year the company had certain powers to make street improvements, but the local authorities did not consider them sufficient, and they agreed to bring in a further Bill for powers to do what was required. They were also asking for power to construct other tramways, and one of these started at Newton-in-Makerfield, and joined the tramways at Warrington. The point on which the District Council objected was that the road was not wide enough.

The opposition of the Newton-in-Makerfield District Council was first gone into, and after evidence had been called, a clause was agreed to which provided that the company should widen Mill Lane, the road in question, provided that the owners agreed to sell, and they should level the roadway under the western arch of the railway bridge and put a footpath there.

Mr. Moon then explained matters with regard to the proposal of the Tramways Committee to supply electrical energy in bulk. The Act of last year, he said, put upon the company the obligation of lighting the streets with electricity through which their tramways passed, and a clause was inserted protecting the local authority from any competition by the company in the supply of electricity. Everyone supposed, therefore, that under their Act, the company had power to supply electricity to authorised distributors if they applied for it, otherwise it would have been quite unnecessary to insert in the Act a protection to the local authorities against competition. But doubts had arisen as to whether the Act did not actually confer that power upon the company, and so in the present Bill a clause was introduced making it clear that they had such a power. They were under an obligation to light the streets of the various local authorities through whose districts they passed, and the local authorities themselves desired that they should be in a position to take electricity in bulk from the company for the purpose of either using it themselves or distributing it to their customers for lighting, power, or for other objects. This proposal was made in the Bill as it went to the House of Lords, but on the objection of the Lancashire Electric Power Company that the tramways company were seeking to obtain all the privileges of a power company without any of its liabilities and restrictions, the Committee, at the suggestion of the promoters, put upon them all the obligations which the Lancashire Power Company were under, with the exception of the one limiting the dividend. The restrictive and protective clauses embodying the decision of the House of Lords Committee were now in the Bill, but the Power Company still opposed them in regard to this proposal to supply the local authorities. The opposition came with a bad grace from the Power Company which had statutory authority to supply the whole of Lancashire south of the Ribble, except certain large towns like Liverpool, Manchester and Stockport, because when they were before Parliament last year they professed themselves willing to meet all and any competition which might be brought against them. It seemed strange in face of this profession that they should now come forward and complain of the application of the Tramways Company. The Power Company had not yet raised their capital or done anything to carry out the powers conferred upon them, and what they were really asking the Committee was to prevent anybody from obtaining sanction to supply electrical energy in bulk in this area because hereafter at some distant date they might, if they got their capital and carried out their works, desire to supply electricity themselves. A weaker case of opposition did not often come before a Parliamentary Committee.

Sir J. Willox, M.P., chairman of the South Lancashire Tramways Company, formally corroborated counsel's statement.

In cross-examination by Mr. Pember, the Witness said that their tramways took them over a very large area of the Lancashire Electric Power Company's district of supply. The Act of last year was not primarily for the supply of electricity. He was also chairman of the South Lancashire Electric Traction and Power Company, Limited, and of the South Lancashire Light Railways Company. In the case which had elapsed since the passing of the Bill incorporating the South Lancashire Tramways Company they had let contracts for the construction and complete equipment of the line which ran through the heart of the district, and constituted practically half the scheme contemplated under the Act. The sum represented by the contracts which had been let was, he should say, between £150,000 and £200,000. It had been found that the South Lancashire Light Railway Company and the South Lancashire Tramways Company could not be effectively and economically administered except by fusion, and so they were merged into the South Lancashire Electric Traction Company, which company was carrying out the works authorised by the Act of last year.

Further evidence was given by Mr. Schofield, clerk to the Atherton District Council, Mr. J. M. Percy, chairman of the Ince Council, and Mr. Mandell, C.E., in favour of the Bill.

On 26th ult. Mr. Waller was recalled with reference to the petition of the South Lancashire Electric Power Company, and said he relied upon Clause 42 of the Act of last year giving them power to transmit electrical energy, and Clause 85, put in at the instance of the local authorities, which prevented them supplying without the consent of the local authorities. On this clause they had taken counsel's opinion, which was favourable to their claim that the Act of last year gave them power to supply electric energy in bulk. He certainly thought it would be a public advantage if the Tramway Company were able to supply the district in competition with the South Lancashire Electric Power Company. The matter of electric supply was distinctly before the House of Lords, and the question was asked whether they were prepared to accept the liabilities and restrictions of an electric light company. Mr. Balfour Browne agreed to do so except with regard to the limitation of dividends, which, he pointed out, could not be expected, seeing that the electric light supply would be a small part of the business. If the Tramway Company could supply the energy at a cheaper rate than the Power Company, it must be an advantage to the public.

In reply to Mr. Pember (for the Power Company) Witness said that neither in the opening speech of counsel nor in the evidence called by the company in the Bill of last year was the matter of the supply of electric energy in bulk mentioned, and he did not know of any tramway company which had got such powers. Theirs, however, was an exceptional system of tramways running through the districts of many local authorities, and some of the local authorities desired that the company should have the powers. It was quite a novelty. He took it, however, that it was clearly understood by the promoters of the South Lancashire Power Bill that there was to be no monopoly, and Mr. Gripper, one of the promoters of that Bill, said they were not afraid of competition.

This concluded the evidence for the promoters.

Mr. Pember, K.C., addressed the Committee on behalf of the South Lancashire Power Company, and said he did not propose to call witnesses because it was entirely a matter of argument. He was there to ask that the electric clauses of the Bill should be struck out—he meant the clauses which gave the tramway company power to supply electricity in bulk to other parties. He ventured to say that they were not clauses which were likely to commend themselves to Parliament. The proposals of the South Lancashire Power Company were considered last year by a hybrid Committee presided over by Sir James Kitson, and all the electric power Bills of the session were referred to that Committee except the North Metropolitan Power Bill. It was only by accident that this Bill was left out, but the Committee which considered it refused to give their decision until Sir James Kitson's Committee reported. Had the Bill of the South Lancashire Tramways Company not been considered to be a tramway Bill pure and simple, there was not the slightest doubt but that it would have been before Sir James Kitson's Committee. There was no reference to the supply of electricity when the Bill was deposited, and it was obvious that there was no such intention. He would like to ask if Sir James Kitson had the slightest idea that when he was considering the Bill of

$\frac{}{2\,g}$ $(V_0^2 \times 2\,S)$.

to another storage battery S_2. Between the two is a Weston

the South Lancashire Company, there was another Bill which proposed to supply electricity in bulk in the same area. The Clause 85 was put in to enable clever gentlemen to say they had full lighting powers. He contended that Clause 42 was put in to give the company power to light their standards not for public lighting, but simply to prevent them being a danger to traffic in the street. It was untrue to suggest that there was anything in the Bill of last year giving power to supply electricity to third parties. He quite admitted that the essence of the Electric Lighting Acts was that of competition, but the meaning of the Act was that if it was expedient that another purveyor of electricity should come into a district the fact that the existing purveyor had an order was to be no bar. But in this case no necessity was shown, and it would be grievously unjust to the Lancashire Power Company if it was allowed. In the present state of electrical enterprise he did not suppose his company would for one moment have taken the Bill if they had thought another company would have been allowed to come in and take the fat parts of the district. As it was he had not the slightest doubt but that the promoters of the Bill that year would seriously hamper and delay the South Lancashire Power Company raising its capital. His company had been twitted with not having raised capital, but there was no foundation for such an aspersion, because of course they did not raise capital till they knew how to apply it, and they first of all had to get people to agree to take a supply. The tramway company was in a different position, and had raised its capital for tramway purposes.

Mr. Moon: It was raised on the prospectus.

Mr. Pember said the evidence was that it was to make certain tramways. Proceeding to deal with the question of promotion, Mr. Pember pointed out that last year when the Tramways Bill was before Committee one of the witnesses stated distinctly that there was no intention of transferring their powers. He thought, however, that the Committee would come to the conclusion that there had been a very strong transfer, and he ventured to say Parliament did not like these transfers. They had heard that the tramways and light railway companies were to be handed over to this joint stock company, which got 50,000 preference shares and 250,000 ordinary shares.

Mr. Moon said no other ordinary shares could be issued.

Mr. Moon pointed out that as a precedent to the Committee the Falkirk Tramways Bill was now awaiting the Royal assent. That Bill, which was heard at Edinburgh under the new Act, allowed the tramway company to supply electricity in bulk to the local authority.

The Chairman asked if Mr. Pember contended that the power company had not had reasonable time to show what they could do.

Mr. Pember: Yes.

The Chairman: And you ask us to strike out the electric clauses in the Bill. If these clauses are struck out and your company does nothing for the supply of electric energy for years to come, would not the district be placed in a difficulty?

Mr. Pember replied that that could be said of every district in which Power Companies had obtained powers.

The Committee decided to confer together in private on the question.

On the parties being readmitted to the committee room, the Chairman asked if the Tramway Company had the power to provide electricity for their own use.

Mr. Moon said they had, and also to light the streets through which their tramways passed.

The Chairman: That being so, and in view of the Lancashire Electric Power Act of last year, the Committee feel that they must for the present defer the granting of powers for supplying the public with electrical energy, to the South Lancashire Tramways Company. Should the Lancashire Electric Power Company fail to commence their works substantially within two years from the passing of their Act then a new situation will have been created which will be suitably dealt with when it arises.

Mr. S. Pope, K.C., on behalf of the National Telephone Company, then addressed the Committee and asked that the company should be offered further protection than that proposed in the Bill against danger to their wires. He said that a tramway company of necessity used a current and carried it in their ordinary wires which was dangerous to the public, and accordingly the Board of Trade provided that they should effectually keep and maintain a guard wire in order that there might be no danger of other wires coming in contact with theirs, and being rendered dangerous. If that were done no danger could arise, but it undoubtedly sometimes happened that a tramway company did not perform their duty, and that a guard wire either through wear or other cause, failed to prevent a falling wire coming into contact with the trolley wire. In that case the current which was dangerous in their wire, and which would not hurt anybody if it were kept in their wire, passed into the smaller wire and became a danger to the public. At Liverpool the Telephone Company had its wires across the street, and by a decision of a court of law, it was entitled to do that. The telephone wire was a small wire, and the electric current which was of so slight a tension as to be perfectly innocuous. At Liverpool there were not only telephone wires, but there was another wire, which, for Corporation tramway purposes, conveyed a current at high tension, and which, if liberated, became a danger to the public. The telephone wires at Liverpool gave way overhead, and falling, came into contact with the wire of the Corporation. Thereupon a current which was not extant in the telephone wires, but was extant in the tramway wires, was conveyed along the telephone wires, and coming in contact with people, caused injury, and proved, in one case, he believed, fatal to life. The effect was that the parties who were injured sought their remedy from the Telephone Company, although they had no control over the dangerous or fatal agency which did the mischief. But, acting upon advice, the Telephone Company paid what damages were sought against them, because they, being the immediate agency of the mischief, felt that the fall of their wires might be held to be the direct cause of the mischief. The result was that the case was not taken to a court of law. The Telephone Company paid the damages, and the result was that they were subjected to this extraordinary state of things, that they could not recover against the Corporation because they were equally with them *tort feasors*. But that was exactly the mischief which the petitioners wished to protect themselves against, and the clause they proposed for insertion in the Bill was as follows:—"Where the company place any electric line above ground, they shall, notwithstanding anything contained in this Act, or in any Act incorporated herewith, be responsible for all damage and injury caused by the escape of their electric current through any wire or apparatus of any other party, and the owner and user of any such wire and apparatus shall not be liable for any injuries caused by the escape of such electric current through his wire or apparatus, unless it be proved to the satisfaction of a court of competent jurisdiction, (1) That the escape of such current was due to the wilful default of the person by, or through whose wire or apparatus such current escaped; or (2) that the person by or through whose wire or apparatus such current escaped, was also using a dangerous electric current." The contention was that were the mischief could only be caused by the liberation of a dangerous current, the person using that dangerous current, and not protecting it, should be liable for the mischief caused by its liberation. The telephone wires were perfectly harmless, and if, in consequence of the tramways company not properly guarding their current, the telephone wires became dangerous, the Telephone Company ought not to be the party responsible for it.

Mr. Moon said the effect of the proposed clause would be that, however negligent the Telephone Company might be in the maintenance of their wires, the Tramways Company were to be liable. If it was only a question of the Tramways Company being bound to maintain a guard wire, he should not object to a clause which would throw upon them the obligation to pay damages for accidents which resulted partly from the negligent maintenance of their guard wires.

After further argument by Counsel, the Committee adjourned and left it to the parties to bring up a clause which might be arranged between them to deal with the matter.

At a further sitting of the Committee, Mr. Forbes Lancaster, who represented the National Telephone Company, said that they had been unable to come to an agreement with the tramway company as to the liability for escaping electric currents. The clause he submitted to the tramway company was as follows:—"If the tramway company place any electric line above ground, the National Telephone Company, Limited, shall not be liable for any damage or injury which may be caused by the escape of electric current from the company's said electric line through any wire or apparatus of the National Telephone Company, unless it be proved to the satisfaction of a court of competent jurisdiction that the escape of such current was due to the wilful default of the National Telephone Company."

Mr. Moon, for the promoters, argued that the proposal was more important than it seemed, because if the telephone company got their clause inserted they would try and get it inserted in every tramway Bill brought before Parliament. In this case the tramway company had, as a matter of fact, a perfectly innocent trolley wire, and so long as it was not interfered with through the negligence of others outside the company no damage was done. It would be by the falling of a telephone wire that a connection would be formed likely to cause damage. Was it not a perfectly fair solution of the difficulty that if both parties were found to have been negligent they should jointly pay for the results? The clause he would ask the Committee to accept was as follows:—"If the Tramway Company have failed to provide and maintain such guard wires and apparatus connected therewith as may be prescribed by the Board of Trade regulations, and injury or damage is caused by the escape of their electric current through any wire of the National Telephone Company, Limited, the company and the National Telephone Company shall be jointly liable for any damage which may be recovered, except in cases in which the injury or damage is caused without any negligence on the part of the Telephone Company, provided that the Telephone Company shall repay to the company the cost of providing and erecting any guard wires and apparatus connected therewith which may be rendered necessary by the erection of any telephone wires after the passing of this Act."

The room was cleared and the Committee conferred in private.

On the parties being re-admitted the Chairman said:—The Committee have carefully considered the two clauses, and the one they prefer, as altered by the Committee, reads as follows:—"If the Tramways Company places any electric lines above ground, the National Telephone Company shall not be liable for any damage or injury which may be caused by the escape of electric current from the company's said electric line through any wire or apparatus of the National Telephone Company, unless it be proved to the satisfaction of a court of competent jurisdiction that the escape of such current was due to the default or negligence of the National Telephone Company, in which case the companies shall be jointly liable."

The clause was added to the Bill, and the other clauses having been gone through, the measure was ordered for report to the House.

Metropolitan District Railway.

Sir J. Kennaway's Committee resumed the consideration of the Metropolitan District Railway Bill on 27th ult.

Mr. Pember announced that the London and North-Western Railway Company were not appearing against the Bill.

Col. Mellor was recalled with reference to the evidence of Mr. Forbes, and said that the Joint Committee on Traction of the two companies worked loyally together, and had practically agreed upon the Ganz system, until Mr. Yerkes came upon the scene with the attraction of his million sovereigns. Then Mr. Forbes said the new system of the American syndicate would be applied to the District Railway and to those lines on the inner circle belonging to the District Railway. Mr. Forbes announced to his shareholders that £400,000 would be allocated to the erection of a generating station on land belonging to the District Company at a cost of £400,000, but the Joint Committee had already a tender for the erection of a station for £200,000. The Metropolitan Railway protested against any system being forced upon them which would put them to grievous expenditure.

In cross-examination, Witness said the Ganz Company only tendered for the inner circle. Mr. Forbes, he submitted, had no idea, until Mr. Yerkes appeared, of adopting any other system than the Ganz system. He was advised that the cable of the Ganz system, if fractured, ceased to be a live cable. He believed that it was true that the direct current system was the system adopted by the majority of railways. The Ganz system was a new system, but it was not to be supposed they had reached finality in electrical matters; under the tender of the Ganz Company the two railways were to find the land for the generating station. He agreed that there was great urgency for the two lines to be electrified, for the Metropolitan Railway Company had been hit harder than the District Railway by the opening of the Central London Railway.

Mr. Pember asked witness whether he would be satisfied if they left out of Clause 13 the words "system to be prescribed by the company."

Witness said he would like time to consider that, as the matter was important, and went to the whole gist of the question.

Mr. Pember said that was his desire that they should go into the gist of the whole matter. His suggestion was that the preamble should be amended, and the following clause inserted:—

"Be it therefore enacted that notwithstanding anything contained in the above-mentioned Act, or in the Act of 1897, or in the Act of 1900, or in the Metropolitan Railway Act of 1898, unless within one month after the passing of this Act the company and the Metropolitan Company shall have agreed to adopt the same system for the working by electrical power of the portions of their respective railways forming part of the inner railway, and also for the working by electric power of the City lines and extension railway, either company may refer the question to the Board of Trade, who shall forthwith hear the parties and determine what system of electrical working shall be applied to the portion of each company's railways forming part of the inner circle railway, and also the City lines and extensions railways, and each of the two parties are hereby required forthwith to apply such system to such portions of their respective railways forming part of the inner circle railway, and the two companies are hereby required forthwith to apply such system to the City lines and extensions railways."

The Chairman said it would be well to adjourn the Committee, so that both parties could come to some agreement.

Mr. Freeman indicated that even if an agreement was arrived at, he did not think the clause suggested would be acceptable.

Mr. Pember was asked for the terms of agreement with the London and North-Western Railway, and read the agreement, which was to the effect that the gauge should be such that the North-Western Company could run their trains over the lines, but that any expense they were put to in altering their rolling stock should be borne by the two companies.

The Committee then adjourned till Friday.

On 28th ult. the hearing was concluded.

Mr. Pember, K.C., said his clients (the District Company) and the Metropolitan Company had met since the Committee adjourned and considered the clause which he submitted and read at the previous sitting. There were two points of disagreement. In the first place, the Metropolitan Company objected to having to arrive at a conclusion as to the method of traction to be used within a month of the passing of the Bill, as was suggested by the clause read on Thursday; and, in the second place, they wished to have a special tribunal to consider the system to be adopted, which should consist of two electrical engineers, one each appointed by the parties, and Lord Shand, or some other person to be appointed by the Lord Chancellor. It was suggested by the Metropolitan Company that the period of consideration should be four months, but seeing that both the companies were losing heavily each week, the District Company thought that was too long, and as a compromise they suggested two months. The District Company, however, considered that the Board of Trade would be the most fitting tribunal to decide the question at issue.

Mr. Freeman, K.C., admitted that the two parties had discussed the matter in a friendly way, but pointed out that there were several matters at issue, and he contended that the clause which had been submitted by Mr. Pember was too one-sided for the Metropolitan Company to accept. What the District proposal amounted to was that if the two parties did not agree within two months as to the mode of traction to be adopted, then the Board of Trade should be called in to decide for them. The Metropolitan Company believed the Ganz system to be the best, but they also believed that the Board of Trade were not prepared to accept it until it had been experimentally tried on the Metropolitan Railway, and it was impossible that this could be done within one month. It would thus be seen that it would be a farce to go to the Board of Trade, and what the Metropolitan Railway wanted was a tribunal presided over by a qualified man with an open mind, and it was to that end that they suggested Lord Shand.

Colonel Mellor was recalled, and stated that Mr. Forbes had repeatedly stated at meetings of the Metropolitan District Railway Company that the Board of Trade would not accept the Ganz system, and therefore it seemed a farce to submit a great question of that kind to a body which had prejudged the question.

The Chairman stated that the Board of Trade were prepared to accept the responsibility.

Witness was questioned by Mr. Pember as to whether he wished it to go forward that he believed the Board of Trade were not impartial, but he refused to go so far as that. All he would admit was that the Metropolitan Company did not wish the Board of Trade to be the arbitrators.

After further discussion, the Chairman said the matter had been fully considered by the Committee, and what they suggested was that the Board of Trade should be invested with jurisdiction to appoint a referee to hear the parties and make a report to them, and then the Board of Trade would decide as to which system should be adopted on the undertakings of both companies.

Mr. Freeman thought this would open the way to an arrangement, but pointed out that the referee ought not to be an electrical expert, as all the experts had made up their minds they wished to have some one not committed to a scientific opinion.

The Chairman thought that the Board of Trade would be able to appoint someone who would be agreeable to the Metropolitan Company.

The Committee then adjourned for consultation to take place with the Board of Trade.

Later in the day the proceedings were resumed, when the Chairman announced that the preamble of the Bill had found to be proved, subject to the insertion of a clause he would read. Before reading the clause he had to express, on behalf of the Committee, their gratification that it had been decided to substitute electric traction on the underground railways, and it was hoped that, as the result of the proceedings in that room, it would mean the ultimate bringing of the companies under one control. The Chairman then read the following clause, which the Committee proposed to insert:—

"Be it therefore enacted that notwithstanding anything contained in the above-mentioned Act, or in the Act of 1897, or in the Act of 1900, or in the Metropolitan Railway Act of 1898, unless within one month after the passing of this Act the company and the Metropolitan Company shall have agreed to adopt the same system for the working by electrical power of the portions of their respective railways forming part of the Inner Circle Railway, and also for the working by electric power of the City Lines and Extension Railways, either company may refer the question to the Board of Trade, whereupon the company shall declare and submit the system which each desires to adopt, and the Board of Trade shall appoint a special tribunal consisting of an arbitrator (not an electrical engineer) and two engineers, one appointed by each company, to hear evidence and report to the Board, which will determine what system of electrical working shall be applied on the portion of each company's railways forming part of the Inner Circle Railway and also the City Lines and Extensions Railway, and each of the two companies are hereby required forthwith to apply such system to such portions of their respective railways as form part of the Inner Circle Railway, and the two companies are hereby required forthwith to apply such system to the City Lines and Extensions Railways."

The clauses were then adjusted and the Bill ordered to be reported to the House.

Cleveland and Durham Electric Power Bill.

This Bill came before a Select Committee of the House of Lords on 28th ult., presided over by Lord Brougham.

Mr. Balfour Browne, K.C., who, with Mr. Russell, K.C., and Mr. Talbot, represented the promoters, explained that the object of the Bill was to incorporate the Cleveland and Durham County Electric Power Company, and to confer on them powers to supply electrical energy, chiefly for power purposes, to anyone within the district who was willing to take it. The main dispute in the case would turn on the opposition of the opposing boroughs who, though they did not actually object to the principle of the Bill, asked for special protective clauses which the promoters were not inclined to give. There were a considerable number of works in the towns specified which were in favour of obtaining a supply of electricity from the Cleveland and Durham Company. There was no opposition on the part of the County Councils of either of the counties affected or from the various Urban District Councils of Lofthouse, Redcar, Ormesby, &c. The Consett Ironworks (Pease and Partners) with a subscribed capital of £20,350,000, and a large number of people in Middlesbrough and other places, representing a total capital of £25,540,000, had petitioned in favour of the Bill, the case of which was very simple. It was promoted entirely by gentlemen carrying on industrial enterprises in the district who suffered very acutely at the present time from the competition of America and Germany, and who were convinced that everything possible must be done to cheapen production if they were to hold their own. In order to facilitate the promotion of the scheme, a preliminary company had been formed, and a sum of £25,000 had been subscribed for the purpose of carrying the Bill through Parliament. The contention of the opposing boroughs, which had not been acceded to by the Committee of the House of Commons, who approved of the scheme, was that they should have

from the Telephone Company, although they had no control over the

an absolute veto on the supply by the company of electrical energy within the limits of the municipal boundaries.

The Chairman: As I understand, you desire to enter into competition with the Corporations of the opposing boroughs for the supply of electrical energy for power purposes only?

Mr. Balfour Browne: Yes, my lord, subject to the approval of the Board of Trade.

The Chairman: You do not seek to enter into competition with them as regards the supply of electrical energy for lighting purposes?

Mr. Balfour Browne: No.

Local evidence having been given in favour of the Bill, the Committee adjourned.

Yorkshire Electric Power Bill.

The Yorkshire Electric Power Bill came before the Examiner in the House of Lords on 27th ult., and Standing Orders were found to be complied with. The Bill will now go for second reading in the House of Lords.

Mansfield Corporation Bill.

The Mansfield Corporation Bill, which has passed the House of Commons, came before Lord Morley's Committee of the House of Lords on Unopposed Bills on 27th ult. Amongst other things, the Corporation is authorised to construct a refuse destructor and generating station, and to supply electricity in bulk outside the borough to local authorities or for traction purposes.

Glasgow Corporation Bill.

The Glasgow Corporation (Tramways and General) Bill, which, under the Private Legislation Procedure (Scotland Act, 1899), came before the Secretary for Scotland in Glasgow, was before the Examiner in the House of Commons on 27th ult. for proof of compliance with standing orders. The Bill authorises the Corporation to make a number of new tramways. Power is also given to borrow money for electric lighting purposes. Standing orders were found to have been complied with.

Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board.

The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board Bill, which has passed the House of Commons and which provides for the various local authorities mentioned forming a Board to carry out electric tramway and lighting works, was before the Examiner of the House of Lords on Monday for proof of compliance with Standing Orders. Standing Orders were found not to have been complied with, and accordingly the Bill will go before the Standing Orders Committee, and a petition presented for the suspension of Standing Orders.

LEGAL.

Foote & Milne *v.* Silcock.

Mr. Justice Ridley, sitting in the King's Bench Division on Wednesday last week, had before him the case of Foote & Milne *v.* Silcock. Plaintiffs are a firm of electrical engineers, carrying on business at 66, Victoria Street, Westminster, and the claim was for £100, the amount of an unpaid bill with interest, which had been given by the defendant, Mr. W. G. Silcock, in connection with some electrical work carried out at the Star and Garter Hotel, Putney, and flats adjoining. Defendant, who was engaged in building the hotel and flats in question, pleaded that the plaintiffs had not completed the work under their contract, and that consequently consideration for the bill failed.

Mr. Rawlinson, K.C., and another appeared for the plaintiffs, and Mr. T. Terrell, K.C., and Mr. C. C. Scott for the defendant.

The signature on the bill being admitted,

Mr. Terrell opened the defendant's case. He said that Mr. Silcock was building this hotel and a considerable block of flats at Putney. Originally tenders had been sought for engines, dynamos, wiring—in fact, for the complete installation, but the proposals were modified, and the plaintiffs, on June 13th last year, by letter, contracted to supply only the necessary mains, distribution boards, switches, wiring, &c., for 440 lamps for a sum of £475, or if they were to do the cutting away, £485. The terms of payment by the contract were to be by acceptances at three months, to be given when work of the value of the acceptances asked for was done, and it was further provided that "for the purpose of calculation, the value of the work done, the branch wiring shall be taken at 19s. per light." What the plaintiffs had not done was: (1) They had not put in seven distribution boards to go with the mains, the value of which was estimated by defendant's electrical engineer at £51 2s.; (2) they had not put in 76 lights, which, at 19s. per light, making allowance for the mains laid, left work value about £58 18s. to be done. Other parts of the work not absolutely completed would cost £7 10s., and there was a switchboard for the assembly rooms which would cost £3. Also there were six arc lamps with brackets and fixing, which would cost £57, and the wiring and boards for the same, £6, yet to be put in. What the plaintiffs had done beyond the contract was to put in extra lights, which, at 19s. per light, would amount to £53 4s. Taking the balance of the account, the plaintiffs had actually work done representing £344, and they had already been paid £380, not counting the £100 on this bill now sued for, and in respect of which his case was they had not done the contract work which alone made the money due.

Mr. Rawlinson, K.C., for the plaintiffs, said the fallacy in his friend's argument was that the work was not complete. Plaintiffs were ready and willing to complete the entire work as soon as they had been paid as under the contract, viz., 19s., in respect of the branch wiring of each light. They had put in 476 lights, on each of which the payment of 19s. was due.

Mr. Justice Ridley: Unless you can show, Mr. Terrell, that the work has not been done, I do not see that you have any answer to the case.

Mr. Terrell pointed out that the mains were not complete, nor the distribution and switchboards. Was he to pay the entire contract price—which this 19s. per lamp worked out to—when the work had not been done, but only half done, merely because plaintiffs had put in the branch wiring?

Mr. Justice Ridley: Yes; that is what the contract says. You may have made an improvident bargain, but there it is.

Mr. Terrell argued that the construction his Lordship was putting on the contract was an improper one, and gave the plaintiffs right to payment for the entire contract, though they had completed only a part of it.

Mr. Justice Ridley: I think he is entitled to say: "I have done the branch wiring of so many lights, therefore you must give me the full amount."

Mr. Terrell: That means I have got, in your Lordship's view, no defence.

Mr. Justice Ridley: That is so.

Mr. Foote, one of the plaintiffs, was put in the witness box; but the case was decided on the point of law on the construction of the contract, and his Lordship entered judgment for the plaintiffs for £100 and costs.

In a second action in respect to a bill of exchange for £30, judgment was also given for the plaintiffs. Execution was stayed with a view to appeal on the money being brought into Court.

Mr. Rawlinson observed that his clients were willing to complete the entire contract work in a fortnight, on receiving payment of the amount due.

Cameron Graham *v.* The National Telephone Company.

At Brompton County Court on 28th ult., before Judge Stonor and a jury, Mr. John Cameron Graham, barrister-at-law, residing at 20, Eldon Road, Kensington, brought an action against the defendants, the claim being for damages for alleged breach of contract. Mr. J. Lawless, counsel, appeared for the plaintiff, and Mr. Compton Smith, counsel, defended. Mr. Lawless explained that his client had paid the defendant company at the rate of £12 per annum for the use of a telephone, the working of which, however, had proved so unsatisfactory, that he felt justified in claiming the return of £6 15s. as damages for breach of contract. The plaintiff stated that in February, 1899, the company put up a telephone at his chambers, 2, Gardens Court, Temple, and another at his residence at Kensington. Almost from the first the working of the telephone at the house was unsatisfactory. After plaintiff had explained in detail the numerous difficulties which arose when he wanted the exchange to put him "through," a good deal of other evidence was called, after which the judge, in directing the jury, said it was for them to consider whether the defendant company had fulfilled their contract to give the services of the telephone to the plaintiff, and if not, whether there had been such a breach of the contract as to justify the claim for damages.

The jury returned a verdict in favour of the plaintiff, assessing the damages at £5.

His Honour gave judgment accordingly.

Mr. Lawless asked that, as the case was one of considerable public importance, the costs might be upon the scale above £10, and his Honour assented.

Ridley *v.* The Windermere District Electricity Company Limited.

In the Chancery Division on 28th ult. before Mr. Justice Kekewich, Mr. Warrington, K.C., said he had a motion in this matter by which the plaintiff sought to restrain by injunction a nuisance by smoke and vibration. There was really no question to be determined except one of fact, and he suggested the case was one for a speedy trial.

Mr. P. Ogden Lawrence, K.C., for the defendants, said there might be a defence in law, but he was not at present fully instructed. The defendants' works had been going on for a very long period.

Mr. Justice Kekewich said that when the parties were ready he would give leave to apply to fix a day for the trial.

Municipal Directory.—Messrs. P. S. King & Son, of Westminster, have published a new year book for 1901—1902 with the title of "Local London." A copy of it is now before us. It is a municipal directory for the metropolis and suburbs, or "greater London," and is certainly compact and cheap (6d. net). Those who want at hand a convenient reference book relating to all the public authorities and departments in this important area, will find "Local London" a useful publication.

experimentally tried on the Metropolitan Railway, and it was

which had not been acceded to by the Committee of the House of Commons, who approved of the scheme, was that they should have

IMPORTANT EUROPEAN ELECTRICAL AND ENGINEERING DEVELOPMENTS.*

By WILLIAM J. HAMMER.

(*Continued from Vol.* 48, *page* 949).

The Steam Engine and its Competitors.

M. Berthelot, the chief chemist of France, and member of the French Academy to represent science in that body, has recently declared himself against the utilisation of steam, which, he declares, is already becoming obsolete, and gives it as his opinion that the future of motive power belongs to gas and petroleum, and that the steam engine will be relegated to museums where other anthropological curiosities from the Stone Age down are collected.

In December last, in opening a discussion on Mr. H. A. Humphrey's important paper, entitled "Power Gas and Large Gas Engines for Central Stations," delivered before the Institution of Mechanical Engineers of Great Britain, Dr. Mond, the well-known chemist and inventor of the Mond gas process, stated that the paper which had been presented appropriately marked the closing century of steam as a motive power and the opening of a century of gas as a motive power.

The author, while in London several months ago, in speaking upon this subject with Prof. John Perry, F.R.S., and asking for an expression of his views, was told by Prof. Perry that with the development of large types of gas engines there was no doubt in his mind but that the steam engine would ultimately be very largely supplanted.

In response to a request for an opinion upon this subject, Prof. R. H. Thurston has sent the author a letter, which, by reason of its very great interest, is published *in extenso*:—

"Ithaca, N.Y., February 22nd, 1901.

"Mr. William J. Hammer, New York.

"My dear Mr. Hammer,—Yours of the 21st is received inquiring about the relative efficiency of the steam and the gas engine.

"The best work to date is practically the same for both engines. Each has delivered the net horse-power with a consumption equivalent to about 1 lb. of good coal. The consumption of such fuel for efficiency unity would be about one-fifth of a pound per horse-power, and these engines have thus both attained an efficiency between the coal pile and the point of delivery of about 20 per cent.

"The steam engine has attained so nearly its limit that further progress under commercial conditions would seem to be likely to be hereafter very slow and to be dependent mainly upon the possibility of increasing the thermodynamic efficiency by extending the thermodynamic range of working temperatures. In the steam engine this range may be increased either by still further increasing the working pressure at the boiler or by superheating the steam, or by both expedients combined. Higher pressures are coming to be available, with progress in the construction of high pressure, presumably water-tube boilers, and we have in Sibley College work employed over 1,000 lbs. without special difficulty, and I have no doubt that we can quite as well as did Perkins two generations ago, use pressures of 2,000 lbs., and probably more. We are now beginning to find practical methods of construction and use of superheaters for ordinary pressures, and I have little doubt that we will be able to superheat steam of those higher pressures in course of time. These improvements should permit the increase of efficiencies by something like 50 per cent., and bring the consumption of fuel down to three-fourths of a pound of good fuel per horse-power-hour, and perhaps within the next generation, if not within ten years.

"I am not prepared to say what should be hoped for with the gas engine; but the indications at the moment would seem to be that, as we have a very much larger opportunity to reduce wastes that now characterise the gas engine than to extinguish those affecting the steam engine, more should be expected from the coming years with the former than with the latter. The gas engine has only now come to be a formidable rival of the steam engine, and is gaining upon it rapidly. The deduction seems fair, therefore, that the next few years should see the gas engine so much improved as to permit it, for many places and purposes, to become a successful rival. In some directions, as at sea, in the locomotive, and perhaps in some other departments, it is possible that steam may continue to hold its place unchallenged, but this is by no means certain.

"It is unquestionably the fact that to-day the gas engine is steadily overhauling the steam engine, and as steadily displacing it in many directions. I think it extremely possible that it may ultimately displace it very largely, but I think that the steam engine is likely to hold a place among economically available prime movers for a long time to come, and no one can say what may be anticipated to follow its further improvement by effectively combining a maximum range of pressure and a maximum range of coincident temperature, the one giving maximum mechanical efficiency and the other maximum thermo-dynamic, the combination yielding what is the main object of selection in practically all cases—production of power with minimum costs on all accounts, production of power with least reduction of dividend-paying capacity.

"Yours very truly,
"Robert H. Thurston."

It seems quite clear from the above and similar expressions one hears from those qualified to speak, that with all the progress that has been made in steam engine practice, in the utilisation of higher steam pressures, superheated and reheated steam, condensing, multiplying of cylinders, improving of boilers, &c., they will no longer satisfy the demands for an economical source of power, and in this country and all over Europe a very large amount of attention is now being given to the development of gas engines of large power, and to the development of improved types of petroleum, oil, benzine, and other promising motive agencies, such, for instance, as the sulphur dioxide gas, or "S O_2" engine, of which I shall have occasion to speak later. The steam engine, up to the present, has been more than able to hold its own, by reason of its universal adaptability and its reliability, even with its comparatively low thermal efficiency. During my recent trip in Europe, I visited many of the largest plants for the manufacture of gas engines, and saw large numbers of gas engines in process of construction and in operation, ranging from 250 H.P. to 1,200 H.P. each. Still larger ones are under process of construction at the present time. Various types of these engines I will describe later in the paper. One of the most promising developments, and one which will doubtless enable steam to hold its own to a considerable extent, is the steam turbine now being manufactured in large sizes, both in this country and abroad, which, by reason of its very great simplicity, slight depreciation and high thermal efficiency, constitutes a steam engine applicable to a very wide field of usefulness, and a formidable competitor of the reciprocating steam engine. The Parsons and De Laval types of steam turbines are extensively used abroad, and are being rapidly introduced in this country, where the Curtis steam turbine is also giving most promising results.

Utilisation of "High Furnace" Gases and Big Gas Engines for Electrical Purposes.

The utilisation of high furnace or blast furnace gases marks an epoch, not only in the employment of gas engines of great power, but in the supplying of a new field for the application of electrical machinery. It is estimated that a blast-furnace having a capacity of 100 tons of pig-iron per 24 hours, produces 7,000,000 cubic ft. of gas daily, equivalent to 2,800 H.P. If we deduct the power required to drive the furnace proper, there remains 2,000 H.P., which, so far, have been entirely wasted and which, it has been found, may be successfully utilised in gas engines, and it appears that only one-sixth to one-quarter as much gas is required as would be necessary, when burning the same gases under boilers for producing steam power, and furthermore we are enabled to dispense with costly boilers. Between 25 and 30 years ago it was customary to burn these gases at the top of the stack. They are even so burned to-day to some extent. They were thought to be too poor in quality, and too variable in composition; too full of dust, particularly metallic particles, tending to clog and injure the moving parts; too full of acid matter, and of too high a temperature to enable their use in gas engines; but means have been found by passing the gases on their way from the stack to the engine through pipes and dust pockets in which the particles settle, and through coke and water scrubbers and saw-dust, so that the temperature is lowered, and the gases sufficiently well cleaned. Even at the Friedenshütte Iron Works which I visited in Upper Silesia, they operated successfully with gas charged with 40 per cent. of zinc dust, which only required more purifiers. Although some analyses show the presence of sulphuric and phosphoric acids and chlorine, the alkalies and lime probably neutralise their effect, and there is no apparent corrosion. There is little trouble from variations in quality, and gas, of a quality which ignites with difficulty under a boiler, works well in a gas engine. The first application of the high furnace gas was made in February, 1895, at Wishaw Iron Works, near Glasgow, with a 20-H.P. gas engine, which indicated 15 H.P. when driven with these gases. During the same year high furnace gases were applied on an 8-H.P. engine at the Cockerill Iron Works at Seraing, Belgium, and at the Hörde Iron Works in Westphalia, Germany, where they were used in a 12-H.P. engine. The first patent for the utilisation of high furnace gases in gas engines was taken out the previous year, in May, 1894, by Mr. B. H. Thwaite, of England. The high furnace gases are similar in quality to the forms of producer and power gas made by Dowson and other processes, and, taken directly from the stack, contain as a rule about 27 per cent. of combustible gases, chiefly carbon monoxide, and a little marsh gas and hydrogen; the balance being mainly (about 57 per cent.) inert nitrogen. It is estimated that at the blast furnaces in England alone, over 2,000,000 H.P. is annually going to waste, which might be utilised for electrical purposes. The gas engine industry is about 30 years old. During that time, one company, the Otto, has sold in England and Germany alone about 37,000 gas engines, approximately 500,000 H.P. As indicating the development of the large gas engine industry, it is interesting to note that the Cockerill Company, of Seraing, Belgium, and its licensees, has sold in less than a year 70 engines of the Delamare, Debouteville & Cockerill system. A "Simplex" engine, connected to a large double-acting blowing cylinder, when employing high furnace gases, showed 886 I.H.P. and 725 B.H.P., with a gas consumption of 101 cubic ft. per B.H.P.-hour, and a thermal efficiency taking the I H.P. of 31·5 per cent. Until recently the speed of these blowers has ranged from 50 to 60 strokes per minute. An ordinary gas engine runs at a speed of 100 to 150 revolutions per minute, according to its size, giving its maximum efficiency at maximum speed. (According to Kennedy and others, a gas engine at one-half load consumes 25 per cent. more gas than at full load). I saw recently at Falvehütte, in Upper Silesia, Germany, a plant equipped with Horbiger and Rogler valves, enabling these blowers, which in this case were operated by steam generated by furnace gas,

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* Abstract of paper read by Mr. W. J. Hammer before the American Institute of Electrical Engineers, February 28th, 1901.

fixing, which would cost £57, and the wiring and boards for the same, £6, yet to be put in. What the plaintiffs had done beyond the

authorities and departments in this important area, will find "Local London" a useful publication.

to operate at a speed of 80 strokes per minute. There are several types of valves now on the market, which enable these blowers to be run at a speed adapting them to be driven successfully by large gas engines.

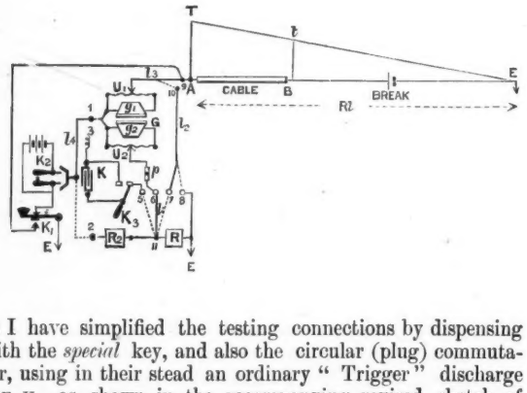
As an illustration of the great increase in the reliability and the simplicity of the modern gas engine, I call attention to an engine which I had the pleasure of seeing at the Cockerill Works at Seraing, Belgium. It has been running steadily for over two years, both night and day, operating with high furnace gas. Prof. Aimé Witz's test showed an average of 181 B.H.P., and a mechanical efficiency of 85 per cent., and 116·5 cubic feet of furnace gas consumed per B.H.P.-hour. The thermal efficiency taking the B.H.P. is 20 per cent. The speed is 105 revolutions per minute. The cylinder has a diameter of 31·5 in. by 39·3 in. stroke. The gas and electric plant at Friedenshütte Iron Works in Upper Silesia is operated by high furnace gases. At the time of my recent visit to this installation, it consisted of two 200-H.P. gas engines direct coupled to two direct current dynamos, and two 300-H.P. gas engines direct coupled to two alternating current dynamos. The gas engines are of the Otto-Deutz type, driving Schuckert dynamos. They were supplying a couple of hundred arc lamps, and several thousand incandescent lamps, and electricity for power purposes. The total H P. was 1,000, and at the time of my visit this was being increased to 2,400 H.P. The entire installation, as it will be in operation shortly, consists of six 300-H.P. engines for power purposes, and three 200-H.P. for lighting. An Otto engine of 1,000 H.P. has been built by this company at Deutz, near Cologne. There are four cylinders of 250 H.P. each coupled direct to a dynamo, the open ends of the cylinders facing one another on either side of it. At these works, I saw many gas engines of great power under construction.

(To be continued.)

CORRESPONDENCE.

Test for Localising High Resistance Breaks.

Since sending to the REVIEW the description of my test for localising a high resistance break, I have availed myself of a very hurried opportunity, before leaving England again, to make a few more experiments which will be interesting to those who have occasion to apply the test; more especially



as I have simplified the testing connections by dispensing with the *special* key, and also the circular (plug) commutator, using in their stead an ordinary "Trigger" discharge key K_1, as shown in the accompanying revised sketch of connections.

To obtain the balance, move both handles of K_2 over to the right, while the plug is in switch p, and adjust R till equilibrium is established between the galvanometer coils g_1 and g_2—always put *negative* pole to cable and positive pole to earth through key K_1.

To measure the charge held by the cable (due to the potentials distributed along its conductor), when the above balance has been effected, leave K_2 over, as for the above test and quickly depress K_1 to earth point 9, and thus remove the testing battery while discharging the cable for a few seconds; then allow K_1 to rise to put the battery on again and note the throw and shunt value.

NOTE.—The shunts U_1 and U_2 used for the balance must be of such a value as will afford a good throw of 150 divisions or more; and the play of K_1 should be so small as only to just break with the lower contact when held by its spring against the upper contact.

To measure the total resistance of the circuit remove plug p and move both handles of K_2 to the right to put the *negative* pole of the testing battery to the cable through galvanometer coil g_1 shunted suitably by U_1—note the deflection and shunt value. Throw both handles of K_2 over to the left to observe the cable current correction.

Constants.—The constant for C.R. by direct deflection method is found by removing l_4 from 9 and connecting it to terminal 10 (as shown by the dotted line) and also shifting l_1 from 6 to 7. The other connections remain the same as for the cable C.R. test. The resistance of the galvanometer coil g_1 (as shunted) should be obtainable from a table of *measured* resistances for coil g_1 shunted with any shunt value likely to be employed.

" —For the capacity constant remove l_4 from 1 to 2; connect condenser lead 3 to 1; leave l_3 on terminal 10 and shift l_2 from 7 to 8; remove l_1 from 6 to 5. Plug remains out of switch p, except for the balance and cable charge measurements.

For this constant R must be made equal to the resistance R l, calculated from the C.R. measurement by direct deflection, and R_2 equal to the galvanometer coil g_1, as shunted for the balance and cable charge test.

Switch both handles of K_2 over to the right to put on the battery, and then move the handles of K_3 over to left (as shown) to charge condenser K through g_1 shunted suitably to give a good throw of, say, 150 divisions at least.

In my previous description of the test I gave some results obtained through a case of artificial cable, 285 ohms long, and having a capacity of 36·6 mfds. In these examples the high resistance break was represented by wire resistance coils equivalent to 20,000 ohms, the special object then being to employ a *steady* fault so as to verify the *principle* of the test and also the correctness of Tables I., II. and III. These tests gave very accurate results (see ELECTRICAL REVIEW, June 7th, 1901, pp. 960 and 961).

I now give three more examples of high resistance breaks in circuit with an artificial cable:—

Example 3.—Wire resistance representing the break

$= 10{,}000^{\omega}$ { Testing battery = 5 Leclanché cells. Fault current = 1 Daniell cell.

Artificial cable $= 285^{\omega}$.

Capacity = 36·2 mfds., *i.e.*, 0·12702 mfd. per ohm.

R l = resistance of circuit measured by direct deflection method

(s reading for g_1 = 500 ; Measured resistance = 723^{ω}) = $10{,}205^{\omega}$.

R l = cable conductor and break resistance = 10,205 − 723 (viz., g_1 shunted) = $9{,}482^{\omega}$.

F = calculated charge held by imaginary cable $9{,}482^{\omega}$ long, having its distant end to earth

$$= \frac{9{,}482 \times 0{\cdot}12702}{2} \text{ mfds.} = 602{\cdot}2 \text{ mfds.}$$

Balance (steady) obtained when R in circuit with g_1 (shunted as g_1) = $7{,}725^{\omega}$.

Cable charge measured (s R = 500, *i.e.*, M-power = 20) = 309 divisions, *i.e.*, 309 × 20 = 6,180 divisions.

Condenser charge (1·0186 mfd.) (s R = 10,000, *i.e.*, M-power = 1) = 203 divisions.

= charge taken up by cable part of circuit

$$= \frac{6{,}180}{203} \times 1{\cdot}0486 = 31{\cdot}926 \text{ mfds.}$$

$$\text{Ratio } \frac{f}{F} = \frac{31{\cdot}926}{602{\cdot}2} = 0\,053017.$$

According to Tables II. and III., th[i]s ratio 0·053017 represents a distance of 27·3838 units † along a cable 1,000 units† long (see margin)

viz.:

0·048375	= 25·0000
·003896	= 2·0000
·000746	= 0·3838
0 053017	= 27·3838

But since the imaginary line is really 9,482 instead of only 1,000 units long, the

Calculated distance of break from testing end

$$= 27{\cdot}3838 \frac{9{,}482}{1{,}000} = 259{\cdot}7^{\omega}.$$

Actual distance of break from testing end = $285{\cdot}1^{\omega}$.

Example 4.—High resistance break in cable core, guttapercha drawn down over the conductor, almost sealing the end. Tested with five cells when placed in a bucket of *fresh* water and connected to the same artificial cable as for Example 3.

R l = resistance of circuit measured by direct deflection

(s reading for g_1 = 500 ; Measured resistance = 723^{ω}) = 1·210 megohm.

R l = cable conductor and break resistance = 1,210,000 − 723 (viz., g_1 shunted) = $1{,}209{,}277^{\omega}$.

F = calculated charge held by imaginary cable $1{,}209{,}277^{\omega}$ long, having its distant end to earth

$$= \frac{1{,}209{,}277 \times 0{\cdot}12702}{2} = 76{,}802 \text{ mfds.}$$

* Abstract of paper read by Mr. W. J. Hammer before the American Institute of Electrical Engineers, February 28th, 1901.

equipped with Horsfiger and Rogler valves, enabling these blowers, which in this case were operated by steam generated by furnace gas,

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Balance (steady) obtained when R in circuit with g_2 (similarly shunted as g_1) = 1,210,000$^{\omega}$ approx.

Cable charge measured (S R = 500, *i.e.*, M-power = 20) = 368 divisions, *i.e.*, 368 × 20 = 7,360.

Condenser charge (1·0486 mfd.) (S R = 10,000, *i.e.*, M-power = 1) = 209.

= charge taken up by cable part of circuit

$$= \frac{7,360}{209} \times 1{\cdot}0486 = 36{\cdot}92 \text{ mfds.}$$

$$\text{Ratio } \frac{f}{F} = \frac{36\,92}{76,802} = 0\,00048081.$$

According to Tables II. and III., this ratio 0 00048081 represents a distance of 0·24052 of a unit† along a cable 1,000 units† long (see margin) } viz: $\frac{480{\cdot}81}{1,999} = 0{\cdot}24052$

But since the imaginary line is really 1,209,277, instead of only 1,000 units long, the

Calculated distance of break from testing end

$$= 0{\cdot}24052 \frac{1,209,277}{1,000} = 290{\cdot}8 \text{ ohms.}$$

Actual distance of break from testing end = 285·1 ohms.

NOTE :—The readings for this test were all steady, and the results therefore reliable.

Example 5.—The above broken G.P. core end, which was almost sealed, was then pierced three or four times with a pin's point to admit water, which, being fresh (drinking) water, and its entry partly obstructed by air pent up in the pin-holes, reduced the resistance at first to only 57,000$^{\omega}$. Under the prolonged negative testing current from five cells the balance kept changing rapidly, but after waiting and watching, the break resistance became rather more settled at about 34,000$^{\omega}$, and when the shunt sliding contact was changed from 500 to 200, the excursions of the galvanometer deflections were brought sufficiently within limits to deal with. Localising a fault of this character, perhaps one of the most difficult that is likely to be met with, is, of course, a rather delicate operation, so that it would not be reasonable to suppose that it can be successfully negotiated without a little coaxing and humouring—sometimes a good deal—but patience even in the most stubborn cases will generally secure a correct result. This particular break-fault proved unusually wayward.

To obtain anything like a steady balance was out of the question, but by averaging out a series of fluctuations to the right and left of the mean value when measuring the resistance of the circuit by direct deflection, and also by obtaining the mean cable charge throw from a number of observations, a very close result was secured, as the following figures show. I should explain that as the galvanometer suspension was often swinging, a favourable moment was taken advantage of when the spot was tolerably steady and near to the zero to depress K_1 in order to discharge the cable, and the swing of the galvanometer was next checked and stopped by the damping coil (placed near to the galvanometer and energised by a few cells and a reversing key near the hand of the operator), and, as soon as the spot was steady, K_1 was let rise and the cable charge throw noted. As in the case of the fall of potential test for a high resistance *partial earth* fault, accuracy will be found in a large number of observations.

C.R. by Direct Deflection Method.

[Shunt-reading for g_1 = 200 ; M-power = 50. Measured resistance of g_1 shunted = 355 ohms.]

1*st Series* of varying deflections :—Mean cable current *after* testing = 2½ divisions on *same side* of scale.

Right side of zero, 122, 38, 160, 22, 180, 8, 145, 73, 145, 67, 120, 27, 178, 157, 32, 170, 47, 40, 43, 167, 75, 105, 102
Left side of zero, , 8, } 92·3 − 2·5 = 89·8 divs.

2*nd Series.*—

Right side of zero, 165, 45, 158, 68, 153, 58, 107, 103, 117, 57, 66, 50, 140, 20, 152, 40, 150, 45, 167, 27, 207, 40, 157, 95, 147, 100, 102, 95, 153, 47, 182, 0 } 100·3 − 2·5 = 97·8 „

Mean of both series (taken as correct) = 93·8 divs.

Constant : 5 cells through 27,355$^{\omega}$ [S R = 200 M-power = 50] = 119 divisions.

Calculated C.R. of whole circuit! = $\frac{119}{93{\cdot}8} \times 27,355$

= 34,705$^{\omega}$.

Cable Charge Throws.

[Slide reading = 200 *i.e.*, M-power = 50, and measured resistance of shunted coil g_1 = 355$^{\omega}$.]

1*st series :* 160, 164, 140, 153, 153, 135, 147, 142, 133, 142, 148, 160, mean = 148·1 divisions.

2*nd series :* 122, 142, 172, 155, 143, 153, 142, 157, 177, 128, 140, 151, mean = 148·5 divisions. (Taken as correct.)

Condenser (1·0486 mfd.) charge [S R = 10,000 *i.e.*, M-power = 1 ; R_3 = 355, and R made equal to 34,350$^{\omega}$.] = 206 divisions.

For this test then we have :—

R l = resistance of circuit measured by direct deflection (including shunted coil g_1 = 355$^{\omega}$) = 34,705$^{\omega}$.

R l = cable conductor and break resistance = 34,705 − 355 = 34,350$^{\omega}$.

F = calculated charge held by imaginary cable 34,350$^{\omega}$ long having its distant end earthed

$$= \frac{34,350 \times 0{\cdot}12,702}{2} = 2,181{\cdot}6 \text{ mfds.}$$

Balance *very unsteady*, but swings equal on either side of zero when R in circuit with g_2 = 27,000$^{\omega}$ approx.

Cable charge measured (S R = 200 *i.e.*, M-power = 50) = 148·5 divisions, *i.e.*, 148·5 × 50 = 7,425·0 divisions.

Condenser (1·0486 mfd. measured (S R = 10,000 *i.e.*, M-power = 1) = 206 divisions.

f = charge taken up by cable part of circuit

$$= \frac{7,425}{206} \times 1{\cdot}0486 = 37{\cdot}795 \text{ mfds.}$$

$$\text{Ratio } \frac{f}{F} = \frac{37{\cdot}795}{2,181{\cdot}6} = 0{\cdot}017325.$$

According to Tables II. and III., this ratio 0·017325 represents a distance of 8·7005 units* along a cable 1,000 units† long. (See margin.) } viz.:

0·039975	= 5·0000
0 005961	= 3·0000
0 001389	= 0·7005
0·017325	= 8·7005

But since the imaginary line is really 34,353 instead of only 1,000 units long, the

Calculated distance of break from testing end

$$= 8{\cdot}7005 \frac{34,350}{1,000} = 298{\cdot}8 \text{ ohms.}$$

Actual distance of break from testing end = 285·1 ohms.

NOTE :—All these tests were made with an ordinary astatic reflecting galvanometer with its four coils joined up differentially, viz., two against two.—Their resistances being equal, but their effect on the suspension differing considerably. This temporary conversion of the galvanometer coils for differential measurements is effected by merely attaching a connecting wire to their junction, from which point the current divides in opposite directions through the two halves of the coil, each tending to neutralise the other's deflecting effect on the suspension.

These examples of tests for the distance of widely differing high resistance breaks have not been selected from among others less satisfactory. They are all and the only tests that the writer has found time to make without even being checked by repetitions. For instance—The test with a break resistance of 10,000$^{\omega}$. (Example 3.*) One of the last days' experiments should have given a closer result, as it presented no greater difficulty than the previous 20,000 break test, and readings were equally steady. There is evidently some small error in the values noted down, which I have not had time to trace by repeating the test ; but I have preferred to include *all* the tests exactly as they work out.

My absence from England for some months will prevent me adding further examples, but those already given show conclusively that the test is sound in principle, simple in application, and the results easily evaluated by means of the tables. For most other faults we have at least one or more good methods, but so far as the writer is aware there has hitherto been no reliable test capable of localising a very high resistance break, and the test under consideration has, therefore, been devised to meet this important want.

John Rymer-Jones.

R. M. Steamer *Campania*,
June 4th, 1901.

* The distribution of charge, (Tables I, II. and III.), are equally applicable to units of *length* or conductor resistance.

left to observe the cable current correction.

$$= \frac{\qquad}{2} = 76{,}802 \text{ mfds.}$$

Storage Batteries.

In your issue of June 21st there is a letter from "The Electrical Company, Limited," giving some results of their "Sedneff cells," and a comparison is made with the best French storage cells. I venture to say that such a comparison is misleading, as it ignores the advances made in this country and in America.

Recent tests show that the "Rosenthal battery," owned by the National Motor Carriage Syndicate, Limited, is far in advance of the Sedneff battery, and probably any other storage battery known.

The "Rosenthal" lead-lead battery by test (see *Automotor Journal* for March, 1901)	gives 33 watt-hours for 1 kilo. of complete cell, and the cells have stood the test of the rough usage in a road vehicle for over three years.
The Sedneff lead-zinc battery	gives 18·50 watt-hours for 1 kilo. of complete cell—used in tramway traction.
The Edison (latest) cell ...	gives 26·46 watt-hours for 1 kilo. of complete cell.
and the best French cells:—	
B.G.S. cell	gives 27·8 watt-hours for 1 kilo of complete cell.
Fulmen	gives 25 do. do.
*Faure-Sellon-Volckmar ...	gives 19·82 do. do.

* Known as the E.P.S. cell in this country.

So much interest is being taken in the problem of obtaining an electric storage battery suitable for road vehicles, and French and American batteries are being so much pushed, that I am sure a genuine success in this country will be all the more appreciated. The battery to fulfil the conditions must be:—Light weight for great output; durable under the very rough use in a road vehicle; capable of being quickly charged; economical in first cost (of high voltage) and economical in use (of high efficiency).

This problem is probably the most absorbing of all electrical problems just now, and the Rosenthal battery, from my own personal experience of over four years, apparently fulfils all the foregoing conditions.

I have had a Rosenthal battery in use in our own electric carriage for over three years, and it now gives within 10 per cent. of its original very high output, and I should say will last some years longer. I have repeatedly short-circuited the cells, and have taken four to five times their normal discharge from them. I have charged the 20-ampere 8-hour cell with 80 amperes in three hours. I have left them totally discharged for weeks in the electrolyte, and have had them out of the electrolyte for long periods, and I have found them after further charge at normal rate to give practically their full output, and not to show any signs of disruption from such rough treatment.

I shall be pleased to show any of your readers the cells which have been in use over three years, and to let them test them and judge for themselves.

Henry F. Joel.

The Leitner Battery.

Mr. Henry Leitner having in your last issue drawn attention to his *invention* of 1895, I think it would be most interesting and instructive to your readers, and especially to myself, if that gentleman would be so kind as to favour us with particulars as to what his invention really is.

His patents of 1895, of which No. 18,034 seems the chief, describe a method of oxidising the surface of a plate by means of *sodium hypochlorite*, the paste consisting of lead compounds heated with *glycerine* or other binding material, with the addition of a small percentage of *retort carbon dust*; the latter evidently for the sake of conductivity.

Going back just 10 years, we find a patent taken out by D. G. Fitzgerald, No. 4,671, 1885, in which he superficially peroxidised his plates by means of *sodium hypochlorite*, later on we come to another patent of Fitzgerald's, No. 335, 1886, in which the active material is formed of lead oxide mixed with *glycerine and water*, solution of a salt, or dilute acid, and *superficially peroxidised* as described in previous patent.

Messrs. Farbaky & Schenek, No. 13,697, 1895, mention the use of coke dust, and in subsequent patents of Andreoli and others carbon dust is used.

In the Leitner cells which I have seen, the grid consists of a perforated sheet of lead with an upturned flange, the perforated sheet being entirely covered by the paste. This is exactly as described by Vaughton, No. 14,622, 1887.

The novelty of the various Leitner patents is, I am given to understand, a very important question at the present moment.

Pb O_2.

Municipalisation or Monopolisation?

A propos of the very able letter in your issue of to-day's date, anent "Internal Competition," I beg leave to draw attention to another phase of that very polyphase question. In your report of the meeting of the London County Council held last week I observe that the question of municipal electric wiring was discussed, and that the Council have authorised the Committee to promote legislation to enable municipal authorities to undertake the wiring of consumers' premises. The London County Council claim to be the foes of monopoly, yet here we have a very healthy specimen of the species they pretend to despise. Should this scheme become law, the vocation of the electrical contractor will be gone, with municipal electricity undertakings all around us, and it becomes a necessity that the contractors of London should hasten to join the National Electrical Contractors' Association, and make a supreme if tardy effort to save the trade from extinction. That there is need of an organised opposition to this latest scheme of the London County Council, we can imagine no contractor so foolish as to deny, and it is to be hoped that contractors will recognise the necessity of nipping this project in the bud, ere it becomes too late. No one is a firmer believer in municipalisation than myself, provided it be not carried to extremes, as in this particular case, when it ceases to be municipalisation, and becomes monopoly pure and simple.

Sidney Frost.

London, *June 28th*, 1901.

Street Lighting.

With reference to Mr. Bate's letter which appears in your current issue, I am anxious to find a "fire proof" glass such as he mentions, and which appears to give such great satisfaction, and if you will kindly let me know the name of this brand, and where it may be obtained, I should be greatly obliged.

F. A. Clarke.

BUSINESS NOTES.

Catalogues and Lists.—Messrs. W. B. Haigh & Co., Limited, of Oldham, have placed before us illustrated lists of their combined engine and dynamo for ship-lighting and private installations, O-type motors, motor-driven band saw machines, and saw benches.

Lists of fan motors, "Universal" measuring instruments, and sundry electric light fittings have come to hand from Messrs. Julius Sax & Co., Limited.

The General Electric Company (1900), Limited, have issued a very neat pamphlet, in which, with the aid of art illustrations, they set out the details of their electrical machinery exhibit at the Glasgow Exhibition. The progress of the company's work in connection with polyphase machinery between the years 1896 and 1901 is shown in Part I.

The Bullock Electric Manufacturing Company, of Cincinnati, has issued a small pamphlet as a souvenir of the Pan-American Exposition.

The New York and Franklin Air Compressor Company, of New York, have sent us a catalogue (B) of their air compressors driven by electricity, steam, water, or other form of power.

The Keighley Electrical Engineering Company, Limited, have published a circular giving prices and details of their Keighley patent house service fuse boxes. We understand that they are being largely employed in connection with some English supply stations.

India.—An Indian exchange understands that it is under contemplation of the Oudh and Rohilkhand Railway authorities to introduce electric fans for use of the administrative offices; 50,000 rupees is said to be the probable cost of the equipment.

Switchboard Work.—The Brush Company have recently obtained several large contracts for switchboard work; including the whole of the sub-station high and low tension switchboards required for the extensive three-phase installation of the city of Dublin; the complete high-tension switchboard for the new station of the Leicester Corporation; and the traction board for the Middleton Corporation.

Electrical Wares Exported.

WEEK ENDING JULY 3RD, 1900.	
Adelaide	Value £30
Alexandria	62
Amsterdam	185
Bombay	411
Brussels	38
Calcutta	76
Cape Town	486
Christiania. Teleg. mat.	46
Colombo	371
Copenhagen. Teleg. cable	571
Durban	450
East London	23
Gibraltar	183
Hong Kong	377
Launceston	360
Madras	685
Malaga	35
Melbourne. Teleg. cable	312
New York. Teleg. cable	12,700
Ostend	5
Rotterdam	50
St. Petersburg	350
„ Teleg. wire	1,205
Shanghai	68
Singapore	36
Stockholm	31
„ Teleg. cable	279
Sydney	446
Tientsin	30
Townsville	105
Total	£20,038

WEEK ENDING JULY 2ND, 1901.	
Adelaide	Value £362
Alexandria	70
Amsterdam	110
Bandjermassin	165
Bangkok	162
Bombay	25
Brisbane	41
Buenos Ayres. Teleg. mat.	150
Calcutta	215
„ Teleg. cable	454
„ Teleg. wire	197
Cape Town	6
„ Teleg. instruments	652
Colombo	140
Copenhagen	2,281
Durban	341
East London	150
„ Teleg. mat.	534
Fremantle	20
Flushing	26
Halifax	44
Hamburg	45
„ Teleg. mat.	200
Lisbon. Teleph. mat.	201
Madras	258
Melbourne. Teleg. wire	1,575
Perth	104
Port Elizabeth	48
Rotterdam. Teleg. wire	70
Shanghai	41
Singapore	202
„ Teleg. cable	47,000
Stockholm. Teleg. wire	99
„ Teleph. cable	13
Sydney	1,761
„ Teleg. mat.	80
Vancouver	203
Total	£57,746

Foreign Goods Transhipped.

Fremantle. Elec. mchnry.	Value £2,260
Perth. Elec. mat.	486
Total	£2,746

Annual Outings.—The employés of the "Robertson" Electric Lamp Company went for their annual excursion on Saturday, June 29th. The party of over 250, accompanied by Messrs. Robertson & Wilson, left Victoria by an early train for Eastbourne, where a most enjoyable time was spent. At the dinner the usual toasts for the King, the firm, and the employés, were given. The employés of this firm number now nearly 500.

The employés of the London Electrical Fittings Company, Limited, held their annual outing and dinner last Saturday at Wateringbury.

Bankruptcy Proceedings.—The first meeting of creditors was held last week at the London Bankruptcy Court, before Mr. E. L. Hough, Senior Official Receiver, under the failure of Charles A. Church, manufacturing electrical engineer and builders' merchant, carrying on business at 42, Hampstead Road, N.W., under the style of H. Conolly & Co. The debtor, who filed his own petition, has lodged accounts showing unsecured liabilities, £2,746, against assets valued at £7,248, or sufficient to provide a surplus of about £4,500, preferential claims for £330 having also been provided for. It appeared that the debtor in October or November, 1898, purchased the business from the liquidator of Henry Conolly & Co. It was then being carried on at 42, Hampstead Road, and 120, Kentish Town Road, N.W. The purchase price of £8,500 was paid by the debtor within three or four months. He had between £3,000 and £4,000 capital and borrowed the remainder on security of property he then owned. The trading proved a success, and a surplus of £17,000 was shown by the 1899 balance-sheet. The debtor had then extended the business, and requiring additional capital he entered into an agreement with another person to take a one-third share in the business in consideration of providing £5,000 or £6,000 as capital. Only £2,000, however, was introduced, and it was then agreed that it should remain in the business at 6 per cent. interest. Repayment of the money was demanded in January last, and it was agreed that the Kentish Town Road business should be taken over at a valuation by the lender of the money. A valuation was accordingly made, but the figures were disputed, and the matter was eventually settled by arbitration, £535 being awarded against the debtor, who has since continued the Hampstead Road business only. He asserts that he filed his petition in order to protect the estate, the Sheriff having entered into possession for the £535. The creditors passed a resolution adjourning the meeting until July 26th on the understanding that the Official Receiver should continue the business with the assistance of a special manager. The debtor, of course, does not admit that he is insolvent, and he intimated that a proposal would be submitted at the adjourned meeting. The following are among the creditors, viz.:—

Shaw, R. S., Kentish Town	£535
Walker, Parker & Co., Limited, Lambeth	150
Thompson, S., & Co., Wolverhampton	45
Harris & Co.	32
Morrison, W.	27
Nicholl & Knight	65

Dissolutions and Liquidations.—Messrs. W. H. Palmer and D. Watson (Palmer & Watson, electrical engineers, Charing Cross Road, W.C.) have dissolved partnership.

Messrs. L. Alwyn and the Hon. R. Cecil Craven (Alwyn & Craven, electrical engineers, Cowcross Street, Smithfield) have dissolved partnership. Mr. Alwyn attends to debts.

Messrs. J. McDonald and W. G. Titherington (J. McDonald and Co., electrical engineers, Canning Place, Liverpool) have dissolved partnership.

Messrs. G. W. Warner and F. C. Shirley, electrical fitters and engineers (Warner & Shirley, Holbein Place, Sloan Square, S.W.), have dissolved partnership. Mr. Warner attends to debts.

Books Received.—"Productions et Emploi des Courants Alternatifs," by L. Barbillion; "La Sèrie de Taylor et son Prolongement Analytique," by Jacques Hadamard. Paris: G. Carrè and C. Naud.

"Designing Ironwork." Part II. By Henry Adams. London Published by the author. 2s. 6d.

Foster's Engines.—Messrs. William Foster & Co., Limited, of Lincoln, have been exhibiting at the Royal Show at Cardiff an 8-N.H.P. portable engine, a 7-H.P. traction engine, a medium-stroke horizontal engine, and a variety of agricultural implements and machinery. An interesting feature was their new design of high-speed vertical engine. This had 8½-in. cylinder and 8-in. stroke, and was fitted with "Foster's" improved belt-driven governor, and designed for speeds of 250, 300, 350 or 400 revolutions per minute, having piston valve, special lubricating arrangements for continuous running, extra large wearing surfaces, and was suitable for coupling direct to a dynamo or for belt-driving. When required these engines can also be fitted with crankshaft governor of the "Robinson" type, which acts direct on the slide valve, and is found to be the most sensitive crankshaft governor now in the market, the variation between no load and full load being as low as 2 per cent. to 2½ per cent. in actual practice. These engines can also be fitted with centrifugal crankshaft governor, and the well-known "Pickering" governor. We ought to mention that Messrs. Foster have now completed their new works at Lincoln, and are turning out simple and compound high-speed vertical engines for electric lighting, portable engines, traction engines, traction wagons, locomotive boilers, thrashing machines, saw benches, corn mills, chaff cutters, vertical, Cornish and Lancashire boilers, &c.

Parliamentary Bills.—In the Commons last week the following Bills were read a second time:—West Cumberland Electric Tramways, Metropolitan Electric Supply, Brighton Corporation, Clyde Valley Electrical Power, and the Yorkshire Electric Power Bill.

Trade Announcements.—We learn that Société Gramme, of Paris, has opened offices and showrooms at 144, Gray's Inn Road, London, W.C., for the sale of all kinds of electrical machinery and accessories. Catalogue sheets of incandescent lamps, small direct-coupled lighting sets, C.C. standard generators, bipolar motors, alternators, rotary transformers, and other electrical machinery have been issued.

Messrs. Easton & Co., Limited, have appointed Mr. F. A. Porter, of 13, Queen's Square, Belfast, and 35, Parliament Street, Dublin, as their sole agent for Ireland.

Mr. A. H. Hunt has been appointed agent for the Walsall Electrical Company, of Walsall, samples of whose goods can be seen at 59, Gresham Street, E.C. The Walsall Company have been appointed agents for the G.I. enclosed arc and incandescent lamps, Paragon power motors, sewing machine motors, &c. Mr. Hunt has many electrical specialities of interest in the way of traction switches, push switches, iron-cased fuses, switchboards, &c.

Messrs. C. Christopherson & Co., of 21, Mincing Lane, E.C., have taken over the business of Messrs. J. Puddy & Co., of 9, Mincing Lane, together with the agency of the Boron Products Company, Limited. Mr. J. Puddy is retiring from business, and all debts relating to his late firm will be attended to by him.

Messrs. Cecil Cooper & Co. have removed from 703, Fulham Road, S.W. to more convenient and extensive premises at 14, Gloucester Road, South Kensington.

ELECTRIC LIGHT AND POWER NOTES.

Albury.—A report on electric lighting, by an expert, is before the Parish Council.

Bath.—Colonel A. G. Durnford, R.E., I.G.B. inspector, held an inquiry last week into an application by the Corporation for sanction to borrow £4,000 for the purpose of additional electric lighting works.

Brierfield.—The D.C. had engaged as consulting engineer for its electricity scheme the electrical engineer for Colne, but the Corporation of the latter borough has decided that as it has a new electricity scheme of its own in hand it would not be desirable to allow the engineer to undertake the additional duties.

California.—According to the *Manitoba Free Press*, the transmission of electric power a distance of 140 miles has recently been accomplished in California. The power is developed on the Yuba River and transmitted at 40,000 volts to the city of Oakland.

Cheltenham.—Colonel A. G. Durnford, R.E., conducted an inquiry at Cheltenham last week into the application of the T.C. to borrow £25,000 for the purpose of electric lighting extensions. Mr. Hamilton Kilgour said the Corporation had at the present time 510 customers with 31,546 lights. There were also 263 arcs and 19 glow lamps for street lighting. The demand was increasing very rapidly. The full electrical capacity at the present time was 1,000 KW. and the demand 700 KW. The Electric Tramway Company would be supplied at 2d. per unit. There was no opposition.

Dublin.—A report of the E.L. Committee of the City Council recommending the acceptance of various tenders in connection with the new electricity works, amounting to £55,322, states that this concludes the allotment of contracts. The original estimate drawn up by the consulting engineer, Mr. Hammond, for the whole of the work was £254,000, increased by later additions to £267,394: the contracts arranged or recommended involve an outlay of £262,596, including provision for contingencies (£5,000) and engineering fees (£12,500), the total being, therefore, well within the estimate. Considering the virulent and unscrupulous abuse which has been levelled at him by a certain section of the Irish Press, Mr. Hammond is to be congratulated on the happy termination of this part of the work.

Eccles.—The Electricity Committee has appointed Mr. C. H. Wordingham to advise the Council upon the scheme of the electrical engineer for the extension of the electric light undertaking.

Frome.—The Electric Lighting Committee has been deputed to visit three or four places which are lighted by electricity.

Gloucester.—The report to which we referred last week was adopted by the Council, together with the Committee's recommendations as to the reduction in price.

Halifax.—The Corporation has fixed the charges for the supply of electricity for lighting purposes at 4d. to 3d. per unit on a sliding scale, and for other purposes at 2d., subject to a discount of 5 per cent.

Ilkeston.—The T.C. on Tuesday resolved to invite tenders for the construction of the whole of the tramways mentioned in the order. It was also resolved that the mains for electric lighting should be laid the whole length of the tramlines, that 20 arc lamps should be fixed at the most important points, and that nine motor cars should be provided.

Italy.—The engineer, Giuseppe Liberi, of Aquila, has submitted a project with application for concession for a catchment from the course of the Liri in the commune of Capistrello, not far from the railway bridge at present in course of construction between Avezzona and Balsorano. The draft would be of 3,300 cubic metres, and would be utilised for the development of electric energy in the district of Fucino for (1) motive power for agricultural purposes and driving threshing machines; (2) supplying the necessary motive power for the use of beetroot wash-houses in the district; (3) supplying current for the transport of agricultural and industrial products in the vicinity; (4) supplying electric lighting to Avezzano and the neighbouring communes. The current, which would be three-phase alternating, would be generated by means of three turbines working under a fall of 48·27 metres and driving the alternators. The energy would be transported by cable at high pressure to Fucino, situated 10 kilometres distant. The project is estimated to cost a sum of 3C0,000 lires.

Kinning Park.—At last week's meeting of Glasgow Corporation it was resolved to apply for a prov. order to supply electrical energy within the burgh of Kinning Park.

Leigh.—The first annual report on the working of the Corporation electricity works presented to the Tramways and Electricity Committee by the engineer, Mr. J. Foster, states that there are now 82 consumers with 4,847 8-c.p. lamps, as against 38 consumers with 1,973 8-c.p. lamps in 1900. Last year 76,988 units were sold, the maximum load attained being 86 kw. For private lighting there were consumed 22,690 units at 7d. per unit, 20,488 at 2½d., 7,666 at 5d., and 3,145 at 3d., whilst for power 4,808 units were sold at 3d., and 18,191 at 1½d. and 1d. per unit. Thus, 53,989 units for lighting purposes brought in a revenue of £1,064 15s., or an average of 4·73d. per unit, and 22,999 units for power produced £119 9s. 5d., or 1·25d. per unit. The amount of capital expenditure to March 31st last was £10,917 7s. 7d. The total revenue last year was £1,187 5s. 11d., and the total costs £572 8s. 8d., there thus being a gross profit of £614 17s. 3d. After paying interest and sinking fund charges, there is a net deficit of £101 10s. 2d.

Leith.—The report of the electrical engineer for the past year shows that the total receipts were £3,172 13s. 10d., and the working costs amounted to £1,416 5s. 6d. The T.C. has agreed to borrow an additional £35,000 in respect of capital expenditure.

Limerick.—The B. of T. has deferred the revocation of the T.C.'s electric lighting order for one year from November 9th next.

London.—Hampstead. — The Borough Council has resolved that 2d. per unit be charged for electrical energy used for power and heat, with a minimum charge of 13s. 4d. per quarter.

Shoreditch.—At the meeting of the Board of Guardians the House Committee received a letter from the Renewable Electric Lamp Company, Limited, of which the Mayor of Shoreditch is a director, stating that it would be wise not to burn lamps more than 600 hours, after which a waste of current ensues and efficiency is diminished. The company offer to renew their lamps after 600 hours' use at half-price, and the Committee recommended that the offer be accepted, and the suggestion of the company acted upon.

Stepney.—The Electricity Committee reported that at a recent meeting they received a letter from the Charing Cross and Strand Electricity Supply Corporation, intimating that they would shortly be laying mains in the borough under the provisions of their Further Powers Acts, 1900, and asking the Council to grant an interview to their representatives, who were desirous of submitting terms for a bulk supply of electricity to the Council. They had interviewed the representatives of the Corporation, and had considered a further letter from them, offering to enter into an agreement with the Council to supply any quantity of electrical energy in bulk at the rate of 2d. per Board of Trade unit upon certain conditions. The Committee reported that they had very carefully considered the matter, and it had been pointed out to them by their consulting engineer that if the offer was accepted, the Council would have to bear the loss on transformation and distribution, to raise the capital (estimated at about £6,000) for the purchase of the machinery in the transforming chamber, to provide for its depreciation, and to bear the cost of maintenance. The addition of these expenses to the charge of 2d. per unit would increase the cost of the bulk supply to the Council to about 2·6d. per unit, which was higher than the cost of generation at any municipal undertaking in London. Under these circumstances, and in view of the fact that the Council approved the resolution passed at a conference of metropolitan local authorities that it was desirable that the London County Council should be empowered to undertake the supply of electricity in bulk for the whole of London, they could not advise the Council to entertain the offer. They recommended that the Charing Cross and Strand Electricity Supply Corporation, Limited, be informed that the Council cannot accept the terms contained in their letter of June 7th. The recommendation was agreed to.

County Council.—Last week the Finance Committee recommended that sanction be given to the borrowing by the Borough Council of Islington of the sum of £3,236 for the installation of the electric light within the borough. The recommendation was agreed to.

Woolwich.—The B.C. is taking steps to obtain a loan of £45,664 for buildings and of £56,643 for machinery and plant for its scheme of a combined dust destructor and electricity works. The Council is inviting quotations for sinking a 45-ft. well at the new generating station.

Southwark.—The Borough Council has approved of plans submitted on behalf of the City of London Electric Lighting Company for the erection of an addition to a block of dwellings in Summer Street, Southwark Bridge Road, for the rehousing of families displaced by their works.

Nantwich.—The D.C. has adopted a scheme of electricity supply drawn up by Messrs. Trentham & Peers, and estimated to cost £14,000.

New Zealand.—The *British Australasian* says that Messrs. Nelson Bros. are about to make use of electric power for driving the hoists and subsidiary machinery in their various large freezing works in New Zealand. Electric motors will replace long lengths of steam pipe and small steam engines.

Newport.—On Saturday night a breakdown on the Corporation electric light mains cut off one of the circuits supplying a number of tradespeople for more than an hour.

North Metropolitan District.—Last Friday the representatives of Wood Green, Tottenham, Edmonton, Southgate, and Enfield met in conference to consider a joint scheme for electric power for the several districts. Last year a joint committee of the several districts was appointed, and preliminary arrangements were made for promoting a Bill in Parliament for the necessary powers, but, owing to an adverse vote of the ratepayers of Enfield and Edmonton, the "combine" was abandoned at the cost of £240 to each of the five authorities. The following resolution was carried *nem. con.*:—"That, in view of the expressed opinion of this conference that the supply of electricity could be generated much cheaper by larger than by smaller undertakings, it is desirable that the Joint Committee of the District Councils of Edmonton, Enfield, Southgate, Tottenham and Wood Green be reconstituted to take into consideration the proposed use of electricity in their respective areas."

Radcliffe.—A L.G.B. inquiry was held at Radcliffe last week regarding the D.C's. application for leave to borrow £21,000 for electric lighting purposes.

Stoke-on-Trent.—The T.C. has instructed Messrs. Trentham & Peers to prepare plans and specifications for the erection of an electricity works.

Stretford.—The D.C. has adopted the report of Mr. C. H. Wordingham on the supply of electricity in the district, and has instructed him to prepare a scheme forthwith.

Sunderland.—According to Mr. Snell's annual report to the E.L. Committee of the Sunderland Corporation, in spite of the difficulties arising from the high price of materials, and from the fact that the department has had to spend a large capital on machinery for tramway purposes (some of which has been earning revenue only part of the past year), the result of the year's work is extremely satisfactory. The number of lamps connected on March 31st was 50,092 as compared with 35,024 on March 31st, 1900, an increase of 43 per cent., as compared with an increase of 36 per cent. for the previous year. The number of units sold was 1,218,768 as compared with 640,079 during 1900, an increase of 90 per cent., as against 35 per cent. increase during 1899. Some of this increase is due to the units sold to the Tramways Committee, but these only represent 256,240 of the total number. The gross profit was £7,254, or 7 per cent. on the average capital outlay for the year. The sinking fund and interest took £5,997, leaving a net balance of £1,257. The total cost of production was 3d. per unit, and the average revenue was 3·25d. per unit. Sunderland stood fourth on the list of charges to consumers out of 118, only Cork, Manchester and Nottingham being cheaper. The total capital outlay up to March 31st, 1901, was £121,914.

Sweden.—The Communal Council of Visby has approved of a project for the construction and installation of an electric power station to cost 175,000 crowns. The Communal Council of Kristianstad has approved of a project for the construction of a central power station to cost 180,000 crowns.

Twickenham.—The Urban Electric Supply Company has taken over the powers to establish an electric lighting system in the district. The company is prepared to give a supply to the neighbouring districts of Teddington and Isleworth if arrangements can be made with the authorities of these districts, both of whom have obtained Parliamentary powers for the supply of electricity.

Walthamstow.—The D.C. has appointed Mr. F. A. Wilkinson, of Salford, electrical engineer, at a salary of £300 a year.

Wimbledon.—A L.G.B. inquiry will be held to-day relative to an application of the U.D.C. for a loan of £7,500 for extending the Council's electricity department.

York.—In his report on the first year's working of the electric lighting station, the engineer, Mr. C. A. Midgley, states that, after payment of all outgoings, including interest and sinking fund, there is a net profit of £98 15s. 9d. The year had created a record which had never been equalled by any provincial station in its first year. Originally Prof. Kennedy installed four engines and dynamos, with a total horse-power of 320. So great was the demand, however, that a 400-H.P. set was installed for the past winter, but even with this set they had not been able to have one of the others laid off, and at the end of the year (March 31st, 1901,) they had a total lamp connection of 16,400 8-C.P. lamps connected, and over 5,000 8-C.P. lamps applied for. The report recommends further expense on mains and extensions for the coming winter of £10,850. The City Council has decided to carry out the extensions suggested.

ELECTRIC TRACTION NOTES.

Birkenhead.—The Electricity Committee recommends that application be made to the L.G.B. for a £40,000 loan in respect of costs and expenses incurred in excess of amounts already sanctioned for the provision of generating plant, mains, lamps, &c., for the tramways.

Cardiff.—The Tramways Committee has instructed the borough engineer to proceed with the new line along Tudor Road and Wood Street connecting Clare Road with St. Mary Street.

Dudley.—The T.C. has consented to the British Electric Traction Company laying a double track from Queen's Cross to Hall Street, on condition that all the cars from Old Hill and Kingswinford are brought into the Market Place.

Glasgow.—In a recent report to the Tramways Committee on the progress of the tramway works Mr. Parshall says:—"The electrical machinery in the sub-stations, and all of the underground cables, have given entirely satisfactory results. There have been no electrical difficulties whatsoever. In the power station the boiler house arrangements are approaching completion. The coal-handling machinery has been tested and found satisfactory. The first economiser has now been put in satisfactory working order, and the second one is well forward. The outside coal-handling machine has been tested and found satisfactory. Generally everything in operation in connection with the boiler house is working well. As regards the engine room, the two Stewart engines, which have been working for some weeks at about half-load, were taken out of work on June 14th, and one handed over to the Stewart Company for general overhauling, the second engine being held as a stand-by for the working of the auxiliary power plant in case of failure of supply from Dalhousie. This second machine will be turned over to the Stewart Company as soon as the first machine is put in working order. What I am asking the Stewart Company to do is to make such arrangements as will enable me to use the engines under usual working conditions. As yet we have been unable to work these engines with the governor, and have had to work them always with a man at the throttle. The little trouble at first experienced from warm pins with the Allis engines has entirely disappeared. No. 1 Allis engine has been carrying the car load for 11 days, and the No. 2 for 16 days. The average load on an engine for 250 cars amounts to some 1,400 KW. The average output from the station amounts to 0·93 Board of Trade units per car-mile, which figure will indicate to you that the system generally is working efficiently and well. As regards the Musgrave engines, the first commenced turning round on Monday last. There have been some incipient troubles from heating, but not more than might reasonably be expected in starting a new engine. The engine will be put on artificial load on Saturday first, provided things go on satisfactorily, and it is expected it will be in satisfactory working order for car load in a week from that time. We are pressing the contractors for the cranes to complete their contract. As you know, these contractors have been a cause of serious delay in connection with the execution of the engine contracts. They are now, however, actually at work overhauling one 50-ton crane, and report the 30-ton crane ready for trial. The condenser and auxiliary plant generally are working satisfactorily, and have given no unusual trouble from the beginning."

Halifax.—On Monday last Major Druitt, on behalf of the Board of Trade, inspected two completed new tramway sections at Halifax, namely, Luddendenfoot to Mytholmroyd, and Northowram to Shelf. The inspector passed the sections, and traffic was opened the same evening. The remaining section uncompleted, is that from Mytholmroyd to the Hebden Bridge terminus, about 1¾ miles. Our correspondent says:—"The municipality are not at present going to undertake further extensions in the out districts. They are going to wait a few years and see if the present system pays. At present it is feared the electricity department and the tramways are losing concerns. But the great point—about which there is much uncertainty—is as to the cost of wear and tear. This will take two or three years to test."

The Tramway Committee have decided to erect a sub-station at Hebden Bridge at a cost of £729.

Heysham.—The U.D.C. will grant an interview to Messrs. W. Heap and A. Ledward, respecting a proposed electric tram system.

Ilford.—The U.D.C. has sanctioned the borrowing by the Council for purposes of electric tramways, for a period of 30 years, of a sum not exceeding £79,644 for permanent ways and buildings; for a period of 20 years a sum of £18,082 for equipment; for a period of 15 years a sum not exceeding £8,217 for cars, and for a period of 5 years, £794 for costs incidental to obtaining the order.

Lancaster.—The T.C. has decided to proceed with the construction of the first two lines of electric trams within the borough. Mr. Tester, the engineer, has been busy for some time with the estimates and plans for the route proposed—from Dalton Square, in the centre of the town, to Scotforth, 1·80 miles, with a line branching off this at the point around by Bowerham Barracks to the Williamson Park, 1¾ miles. The total estimated cost, including the car shed £1,325, is £26,960. This includes the equipment of the line but not the cost of the generating station. Tenders are to be invited by the Tramways Engineer for the work. The Birmingham syndicate made an amended offer to the Electric Trams Committee to buy up their rights in order that they might also take over the horse-car business of the Lancaster and District Tramways Company, who own the line from Lancaster to Morecambe, and convert it into electrical tramways, but the Corporation Electricity Committee have unanimously refused to negotiate. They may, however, renew their offer to the tramway company, in order to avoid having two classes of trams in the borough under different management.

Leicester.—At the conference of the Association of Municipal and County Engineers held here last week, Mr. W. Howard Smith read a paper on "Permanent Way for Electric Tramways"; Mr. E. Manville read one on the "Methods of Safety for the Overhead Electric Trolley System," and Mr. Worby Beaumont introduced the subject of the wear of roads by horse haulage and motor traffic.

Liverpool.—At a meeting of the Tramways Committee of the Liverpool City Council on Friday a report by the general manager of the tramways, Mr. C. R. Bellamy, on lifeguards and accidents on the Liverpool system, came before the Committee. The chairman, Mr. E. L. Lloyd, in moving the adoption of the report, said that the Committee had given the greatest consideration to the question of lifeguards in order to devise something which might be regarded as a sufficient protection to the public, especially to prevent children getting under the cars. From statistics in the report there was abundant evidence that there were fewer accidents than seemed to be generally thought. The Committee had given orders for equipping a number of cars with a special kind of lifeguard and also with a ventilating apparatus. It was proposed to ventilate 300 cars, but the patent referred to would be used as an experiment first on 20 cars. The general manager's report was subsequently read. It stated that in the year 1900 the head constable reported 510 cases of persons being run over in Liverpool by vehicles of all kinds. 162 persons were knocked down by horse and electric cars and omnibuses. The experience of the last two years showed that there was less risk of fatal accidents under electric traction than horse traction, having regard to the magnitude of the traffic. During 1900 there was one person killed under horse traction in every 5 millions, and under electric traction, one in every 10 millions. In 1898, with horse traction, the fatalities were one in 6 millions; in 1899 with mixed traction, they were one in 8 millions, and in 1900 with electrical traction, one in 7,500,000, and in the half of the present year they were one in 9 millions. Since the electric cars were introduced, seven persons had been killed. The general manager recommended the use of the lifeguard of the plough type as affording the greatest safety, and that a hundred cars should be fitted with it. The estimated cost was £6 a car, but the actual cost would be rather less.

On Sunday last the electric car route by way of Cazneau Street and Norton Street, Liverpool, was opened for traffic. The new route will form a connecting line between the centre of the city and an existing line working to and from the north end of the city. The length of the north end line in Strand Road, Bootle, has also been opened for traffic.

The subject of overcrowding the cars has been considered by the Tramways Committee, and the general manager of the tramways, Mr. C. R. Bellamy, has been instructed to have the cars licensed to carry 74 passengers each. Many of the cars are supposed to comfortably seat 56 persons, the new limit will, therefore, admit of passengers standing inside and outside. Standing on the platform and staircase will not, however, be allowed.

Middlesex.—The County Council last week decided to refer all matters affecting light railways and tramways to the Special Committee, and sanctioned, amongst others, the proposed applications for the following lines:—

No. 1.—A line of 6 miles 2 furlongs 2·4 chains in the parishes of Staines, Lateham, Ashford, Littleton, Sunbury and Hampton. This line would be in connection with the already authorised Staines and Egham Light railway. Estimated cost, £99,206.

No. 2.—A line of 6 miles 1 furlong 0·70 chain in Staines, Stanwell, Heston, and East Bedford, terminating at Hounslow station, £94,671.

No. 3.—A line of 4 miles 0 furlong 1·45 chains in Twickenham, Hampton, Hanworth and Sunbury, £68,700.

No. 4.—A line of 2 miles 5 furlongs 9 chains in Isleworth, Twickenham and Hanworth, £42,946.

The other lines affect the districts of Chiswick, Hornsey, Tottenham, Wood Green, Islington, Hampstead, Marylebone, Willesden and Paddington. The Committee was authorised not to proceed with any part of the above lines (Nos. 1 to 4) it may be deemed desirable to hold over, pending the application of the London United Tramways, Limited, as to some of the routes. It was also decided to take steps to protect the County interests as to the schemes of the London United Tramways Company. The preparation of working drawings, specifications, &c., for tendering purposes will be carried out by the Council under the supervision of the county engineer, with the assistance of a specially qualified assistant engineer and draughtsman, who will be advertised for at a salary of £600 per annum.

Nottingham.—The Bulwell-Great Market Place section of the Corporation electric tramways is now practically complete. A certain amount of paving, however, remains to be carried out, but it is hoped that the electric cars will be running by the middle of the present month. This is the longest section of all in the new scheme, and is the second to be completed, the Sherwood-Great Market section having been opened for traffic at the New Year. On the Trent Bridge section, work is being pushed forward rapidly. It is the desire of the Tramways Committee to have the Trent Bridge and Station Street sections completed by the end of the summer. At Monday's meeting of the City Council, Alderman Brownsword (chairman of the Tramways Committee) replying to a number of questions, said it was not the intention of the Committee to put electric lamps on the Bulwell route any further than Alfreton Road and Derby Road. They hoped to get at the Lenton Boulevard section of the tramways early in the spring of next year, or very early in the summer. The reason the Committee put electric lamps on Mansfield Road and Alfreton Road was that, having centre poles (though there was no law to that effect), it was understood and pressed by the Local Government Board that every other pole should have a lamp, because during foggy weather it was dangerous to traffic unless there was a means of distinguishing the poles. The Committee did not propose to light up the rest of the route—that portion where there were side poles—because it was not the business of the Tramways Committee to light the streets; it was the business of the Lighting Committee, and up to the present time the Tramways Committee had not been able to induce the Lighting Committee to even undertake the expense of the lamps that were put up. The Tramways Committee were bearing the whole of that expense

St. Helens.—The third length of new electric tramway in Smithy Brow, Corporation Street, and Shaw Street, St. Helens, was inspected on Thursday last week by Colonel Von Donop, representing the B. of T.

South London.—In reply to questions as to when the London County Council would commence the conversion of the tramways to electric traction, Mr. J. W. Benn stated on Tuesday that the erection of the generating station would defer the installation for a long time. The Highways Committee had, however, caused inquiries to be made, and could see their way to obtain power in the district at an earlier date, so that the cars might be seen in operation in 18 months.

The Highways Committee reported that the forms of contract and specifications were being prepared for the supply of the direct current and three-phase current plant required for the generating station to be established in connection with the electrical working of the tramways. The Council's standing order relative to retention moneys under contracts, provides that in the case of contracts not exceeding £100,000, payments shall be made at the rate of 80 per cent. of the value of permanent work executed, until the amount due in respect of the contract and remaining unpaid shall be equal to 10 per cent. of the contract price; and, further, that half of the retention money shall be paid on completion of the work, and the balance at the expiration of the period of maintenance. It has been represented by Dr. Kennedy that as regards the supply of the machinery now under consideration, the arrangement provided for by the standing order would cause the contractor to be kept out of his money for a considerable period, and that, of course, this would be taken into consideration by persons tendering, and the price would be higher than if a different arrangement, which he suggests, were adopted. Having given careful consideration to the matter, the Committee were of opinion that as regards these particular contracts an arrangement should be made for the contractor to be paid 50 per cent. of the value of the machinery upon it being delivered at the site, 30 per cent. after the machinery has been erected in position, 10 per cent. after being taken over, and 10 per cent. after 12 months' maintenance. A recommendation to this effect was adopted without discussion.

Southport.—The Cambridge Road line to Churchtown was officially inspected on behalf of the Board of Trade by Major Druitt, R.E., on Tuesday.

Stroud.—The locality is considering Mr. Nevins's scheme for an electric railway connecting Stroud with Nailsworth, Painswick, Stonehouse and Chalford.

Sweden.—For some time past the question of converting the Swedish West Coast Railway into an electrically-worked line has been under discussion, and different projects have been put forward. The latest suggestion is that the motive power be taken at Karsefors, near Laholm. The installation, including the purchase of the Falls, would cost 3,000,000 crowns.

Twickenham.—After preliminary discussion, the U.D.C. has decided against many of the clauses in the rival light railway schemes proposed by the Middlesex County Council and the London United Tramways, Limited, respectively; but the view is expressed that, subject to satisfactory arrangements, it would be advisable to adopt the company's scheme as against the County Council's. The chairman and the clerk have been authorised to take the necessary steps to oppose at the coming inquiry at Hounslow on 22nd inst.

Warrington.—The B. of T. have sanctioned the loan of £66,050 for the construction of tramways in the borough.

TELEGRAPH AND TELEPHONE NOTES.

Bristol Telephones.—The members of the Corporation inspected the new headquarters of the National Telephone Company on Tuesday. The building is a commodious one, and the arrangements are of the most modern character. The visitors were particularly interested in the switch room erected in the rear of the main block. This is a fine apartment, 70 ft. 7 in. in length, 31 ft. in breadth, 29 ft. in height and having a lofty lantern top. It will provide for 6,000 subscribers, and as the number already connected is 1,500, extension room is ample.

French National Submarine Cables.—The French Chamber of Deputies, in the name of the Commission of the Colonies, has recently issued a report dealing with the subject of Nationalizing French Submarine Cables. In January, 1900, a Bill was brought in relating to the establishment of various Colonial cables, but this was only an incomplete scheme, and did not touch the financial question. In a report which was issued in June of the same year, it was pointed out that any scheme to be successful must be one of arrangement with existing companies under new guarantees or new companies. The financial position of the one and only existing cable company in France, the Compagnie Française des Cables Telegraphiques, did not permit of its resources being utilised without a complete reorganisation; this reorganisation the report fully considers. It proposes, amongst other recommendations, the reduction of the capital of the company from 24 to 14 millions of francs (£960,000 to £560,000); the issue of eight million preference shares for the repair of the Pouyer Quertier cable; the construction of a third cable ship; and the establishment of a reserve fund to meet any falling off in traffic receipts which may take place; the State to advance, if necessary, the sum of one million (under deduction of guarantee proceeds) to meet a deficiency arising from a falling off of traffic; the advance to be subject to interest and to be payable back. In return for these (and certain other) advantages, the State requires the company to partially renew the Pouyer Quertier cable, to purchase a cable ship, and eventually (when the traffic requires it) to lay a new trans-Atlantic cable; certain conditions, with a view to establishing new lines, are also imposed, the State reserving to itself the power of making arrangements with the company for the *construction* of new cables, the company procuring the necessary funds by the issue of shares, to be paid back by means of annuities, and the cables becoming the property of the State. The convention places at the disposal of the State the company's fleet for the repair of its own cables. The report considers that the proposed system will enable certain cables in the Indian Ocean, which are at present without commercial value, to be worked advantageously in combination with the cables of other companies; also that the restoration of the Compagnie Française would result in the influx of capital for the promotion of new companies. It is considered that the French company, if properly organised and worked, would prove a formidable competitor with the Anglo-American companies, and that the State subsidy would never require to come completely into force. The State would practically control the organisation and the operations of all kinds of the company. It is pointed out that two of the most useful lines of the projected system—namely, from Hué to Amoy and from Oran to Tangier—were laid with great discretion and rapidity, and form very important links with Indo-China and with Tangier. The report expresses the sentiment that "the national work of the enfranchisement of our exterior telegraphic relations has at last emerged out of the period of uncertainty, the prolongation of which excited our patriotic impatience and the sceptical irony of the foreigner."

A Bill was distributed in the French Chamber on June 25th authorising the Minister of Commerce to purchase the cables serving the West African colonies, to maintain the existing subventions, and to raise the sum of 3,600,000fr. with which to pay the West African Telegraph Company.

(Continued on page 23.)

THE GENERATION AND TRANSMISSION OF ELECTRIC ENERGY AT AND FROM COAL PIT CENTRES.

By B. H. THWAITE, C.E.

(*Continued from Vol.* 48, *page* 806.)

Transformers.—The transformers, which reduce the pressure from 10,000 volts to 150 volts, are partly located in transformer houses and partly in single cabin installations, supported on distributing masts, as shown in fig. 16. The transformer houses, made of corrugated iron, are divided into three compartments; one contains the transformer,

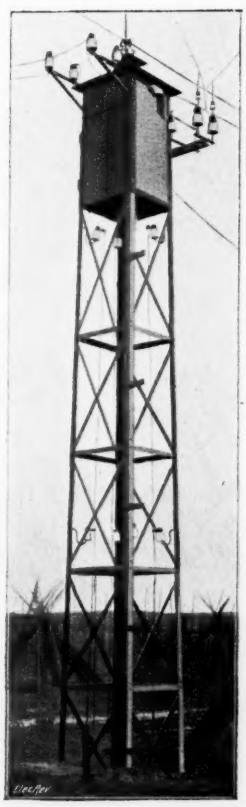


Fig. 16.

another the switching apparatus, and the third the low pressure switchboard and a telephone.

One of the transformer houses is shown in fig. 17. Each house is equipped with the necessary switches and terminal screws for central measurements, and with horn lightning arresters, choking coils, and safety connections. The making and breaking of the connections can be safely effected whenever required, special cut-out tongs, similar to that shown in fig. 8, being provided. These tongs are made of wood, the handles being connected to earth by means of a flexible cord.

All the transformer stations are telephonically connected to each other and to the generating station, and are so arranged that conversation can be carried on, even if the telephonic conductors are influenced by the high pressure mains. All the main supply lines, whether at the high or low pressure, are overhead.

Mannesmann tubes are employed on which the insulator supports are firmly clipped. The tubular and bracket supports are shown in figs. 18 and 19.

Each community has a special agreement with the Electric Supply Company for street lighting with arc and incandescent lamps.

System of Charging for Current.—The small private installations pay on a periodic scale per lamp. The larger installations are equipped with meters. For lighting purposes a charge of 6 pfgs. is made per hecto-watt-hour, with a scale of discounts to large consumers ranging up to 50 per cent. Electric energy for motors and heating purposes is supplied at the rate of 2 pfgs. per hecto-watt-hour.

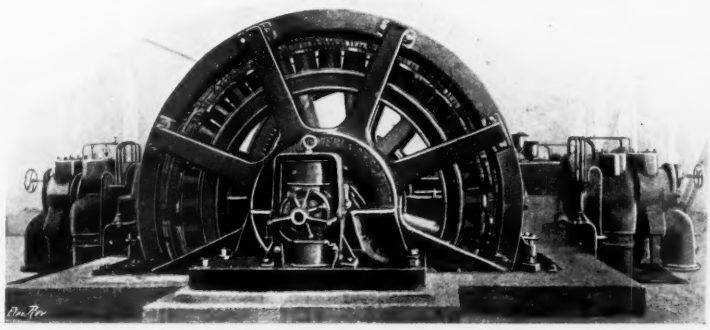


Fig. 21.

Fig. 18.

In the generating station a converter is in use charging a battery for an electric automobile, that runs daily between Wiesloch and Walldorf. The energy at present is absorbed principally for lighting purposes, but motors are being installed. Those in use are monophase motors of the Lahmeyer type, which have obtained a high reputation for their ample overload margin and smooth running capabilites.

The transformers are of the Kern type, as shown in

Fig. 17.

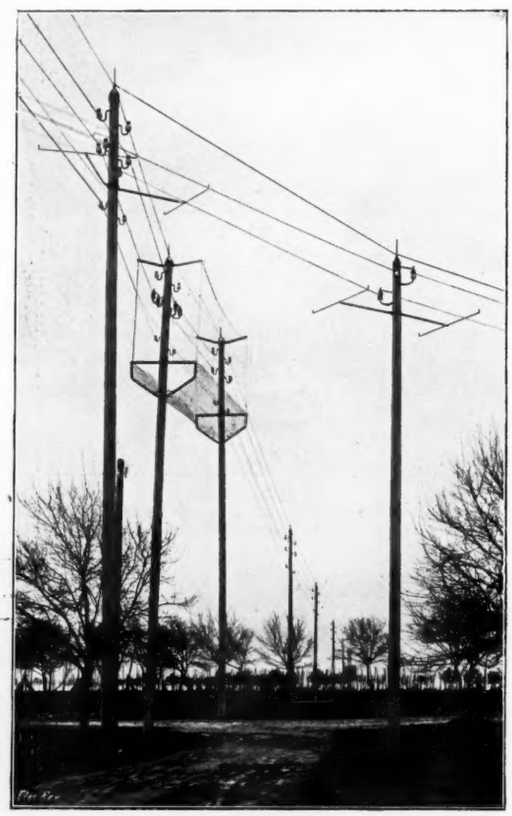


Fig. 19.

fig. 20. The success of this installation has been striking, and extensions are already under consideration.

The firm of Lahmeyer & Co., known as the Electricitäts Aktien Gesellschaft, have in recent years successfully carried out many high voltage polyphasic transmission projects, and their electric generating stations are models of excellent design and workmanship. Fig. 21 shows a Lahmeyer

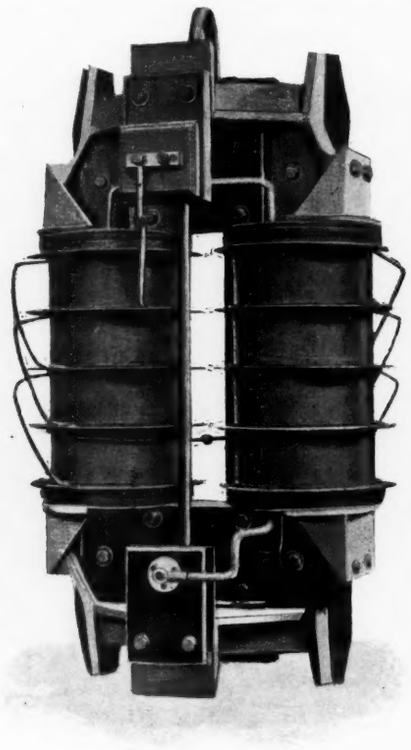


Fig. 20.

alternator driven by a Thwaite-Gardner blast furnace power plant, the first one to be employed for producing calcium carbide.

(To be continued.)

ELECTRIC POWER SUPPLY ON TYNESIDE.

The power system which we now propose to describe is especially interesting in that it is the first in this country to meet the motive power requirements of large manufacturers, each having an average load of 400 H.P. and upwards.

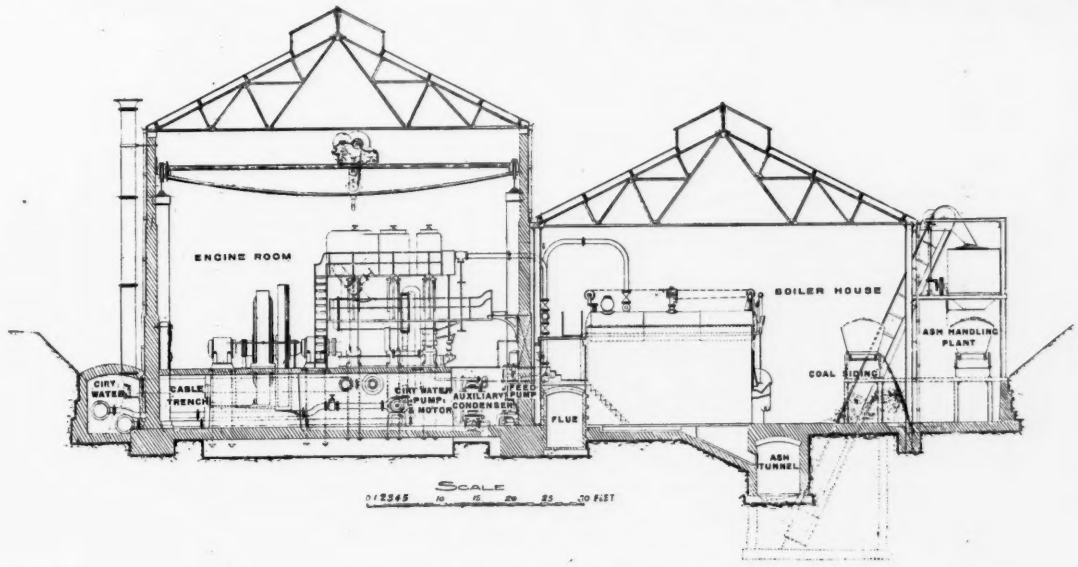
The generating station at Neptune Bank, which is now working, is the preliminary power station begun over a year ago by the Walker and Wallsend Union Gas Company, on a somewhat smaller scale, and since taken over by the Newcastle Electric Supply Company. The latter, as our readers are well aware, has carried on the supply of electricity to a large portion of Newcastle-upon-Tyne for about 11 years, using the single-phase alternating current system and house transformers; even under these adverse conditions the company won its way to a very high reputation on the score of the low price of supply, holding the premier position in this respect for some time.

The company, however, was not satisfied with a mere lighting load, and for some time past it has had in contemplation the erection of a new generating station, with a view to raising the load factor by a motor load, and at the same time escaping from the legal troubles caused by the emission of smoke. When the Gas Company obtained statutory power last year to supply electricity, the Supply Company at once opened negotiations with the former, and arrived at an agreement, according to which the Supply Company relieved the Gas Company of the whole of the work connected with the generation of electricity, and arranged to supply it in bulk to the latter for distribution within the Gas Com-

pany's area. At the same time the Supply Company obtained by transfer the provisional order of the Walker Urban District Council, and thus completed the formation of what is probably one of the finest areas for electricity supply in the world.

sary on the riverside site which has been obtained by the company, and which is shown on the accompanying plan of the district.

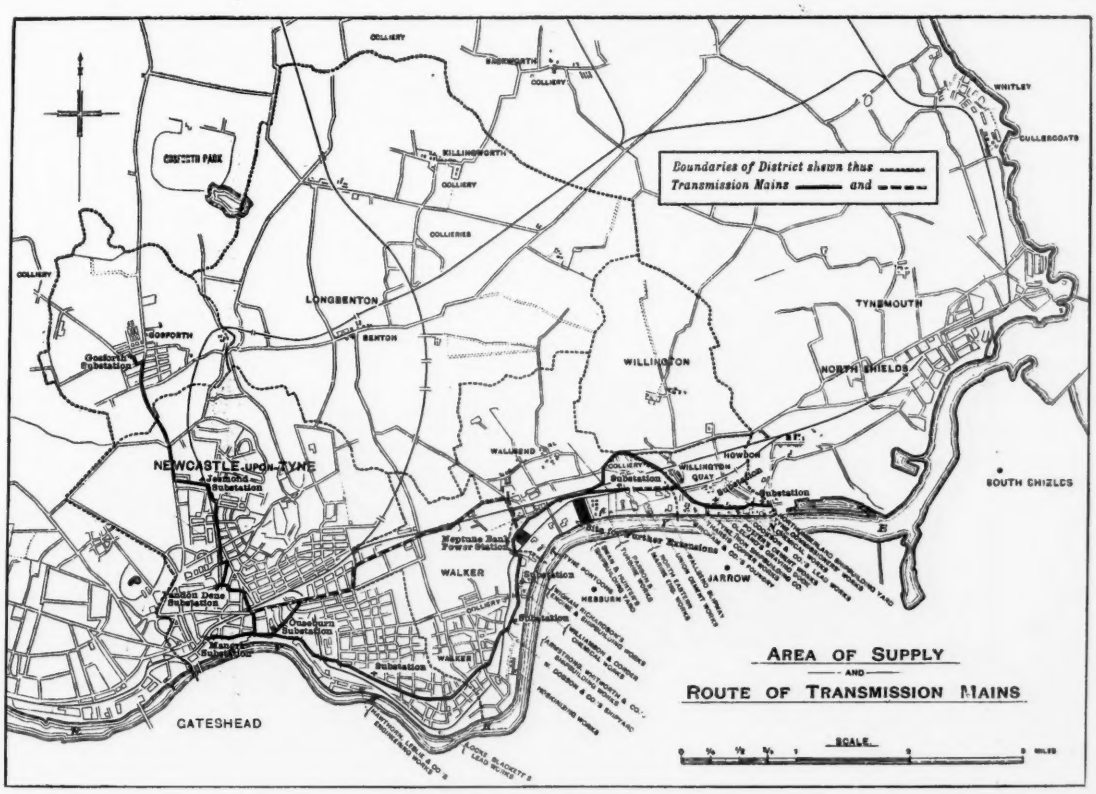
The power station was designed by the Gas Company for supplying three-phase current at 5,500 volts, with a frequency



Cross-Section of Power Station.

When the Gas Company obtained its powers, Parliament refused to allow it to utilise any site but one which it had purchased (for gas purposes) at Neptune Bank, Wallsend; this, therefore, had to be adopted in the first

of 40 cycles per second. The sub-stations are provided with stationary transformers and synchronous motor-generators, both supplied at the full voltage, whereby current may be obtained either at 440 volts three-phase for motive power, or



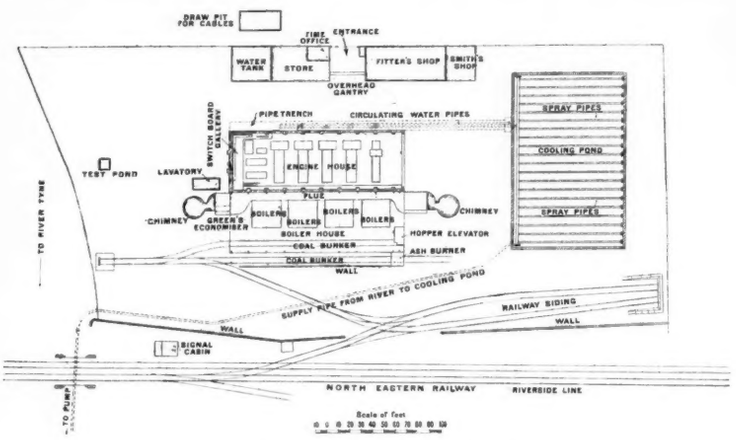
Map of the District.

instance, although unfortunately it is not actually on the river.

In view of the position of the site, the station was laid out for a moderate capacity only; when the plant described below, and now being completed, becomes fully loaded, it is intended to locate all further machinery that may be necessary

at 480 volts direct current on the three-wire system for lighting and power. The frequency and voltage were chosen so that, as far as possible, standard machinery might be employed, thereby obtaining better delivery and reasonable cost.

When the power station was taken over by the Newcastle-upon-Tyne Electric Supply Company, the increase in the area of distribution suggested the desirability of increasing the primary voltage. This was, however, abandoned, as the saving in conductors was almost counterbalanced by the increased cost of the insulation required by the Board of Trade. The sub-stations situated in Newcastle will therefore work under the same conditions as those of the Gas Company, and will be placed in positions affording the greatest economy in low-pressure feeders.



Plan of Works at Neptune Bank.

The position of the Neptune Bank site will be found on the accompanying map of the district, from which it will be seen that it is some 350 yards from the river, and close to the riverside branch of the North-Eastern Railway, in connection with which a siding is arranged. Coal-wagons are run on to this, and are shunted into the coal depôt above the bunkers by means of an electric locomotive supplied with current from an overhead trolley line.

Buildings.—The relative positions of the various buildings, &c., connected with the power station may be seen on the plan of the site.

The stores and fitting-shops are connected by means of a girder, on which runs a small travelling crane.

The cooling-pond to the north-east is provided with Messrs. Korting Bros.' patent nozzles, and is capable of dealing with 325,000 lbs. of circulating water per hour. This pond had to be installed to meet the difficulty which arose from the fact that the power station is considerably above the level of the river; it was found that the cost of pumping the whole of the circulating water, thereby necessitating long lines of large piping and a pumping station situated on the river bank, placed this course almost out of the question. The arrangement, as it now exists, consists of a rotary pump, electrically driven, placed in a pit at the side of a small stream, which at high tide affords sufficient water to make up for any loss due to evaporation at the cooling pond.

It will be seen from the drawings of the power station that the engine and boiler houses are of the same length and width, namely, 160 ft. long × 52 ft. wide.

The firing level of the boiler house is the same as that of the basement of the engine room, the floor of the latter being 8 ft. above this, which is also the level of the siding. This arrangement simplifies both flues and pipes.

The height of the engine room from basement floor to cranes is 40 ft. 6 in., and a 25-ton traveller runs the full length of the building.

The switchboard gallery is 10 ft. above the engine room floor level, and from this the upper platforms of all the engines can be reached by a gallery running the full length of the building. A door also opens from the switchboard gallery into the boiler house, and affords a ready means of access to the boiler stop valves, &c.

The necessary communication between switchboard and engines for starting up, synchronising, &c., is provided by engine-room telegraphs of the marine type.

Both high pressure and low pressure main switchboards are placed on the gallery; auxiliary machine, feeder, and station power and lighting panels are arranged underneath these. Other auxiliary panels control the various station motors.

The space directly below the switchboard gallery is divided from the remainder of the engine room, so as to avoid danger of interference with the cables, rheostats, &c., below the switchboard. All the connections to the auxiliary machine and feeder panels are made behind the dividing wall.

The basement is divided into two portions; one provides for piping, feed pumps, Wheeler condenser, oil separators and other auxiliary apparatus in connection with the steam plant; the other portion is reserved for cables, rheostats, &c. Each of the high pressure cables running between the switchboard and the machines is made up of three single insulated cables, braided together and run in iron pipes. No dividing boxes are required at the machines, as the braiding is stripped back, and the separate cables connected with the machine terminals.

The low pressure machine, exciting and power cables are single, rubber-covered, and are cleated to the walls by means of porcelain insulators carried in iron frames. The feeder cables are brought into the station through wrought-iron bends, directly below their respective terminal lugs.

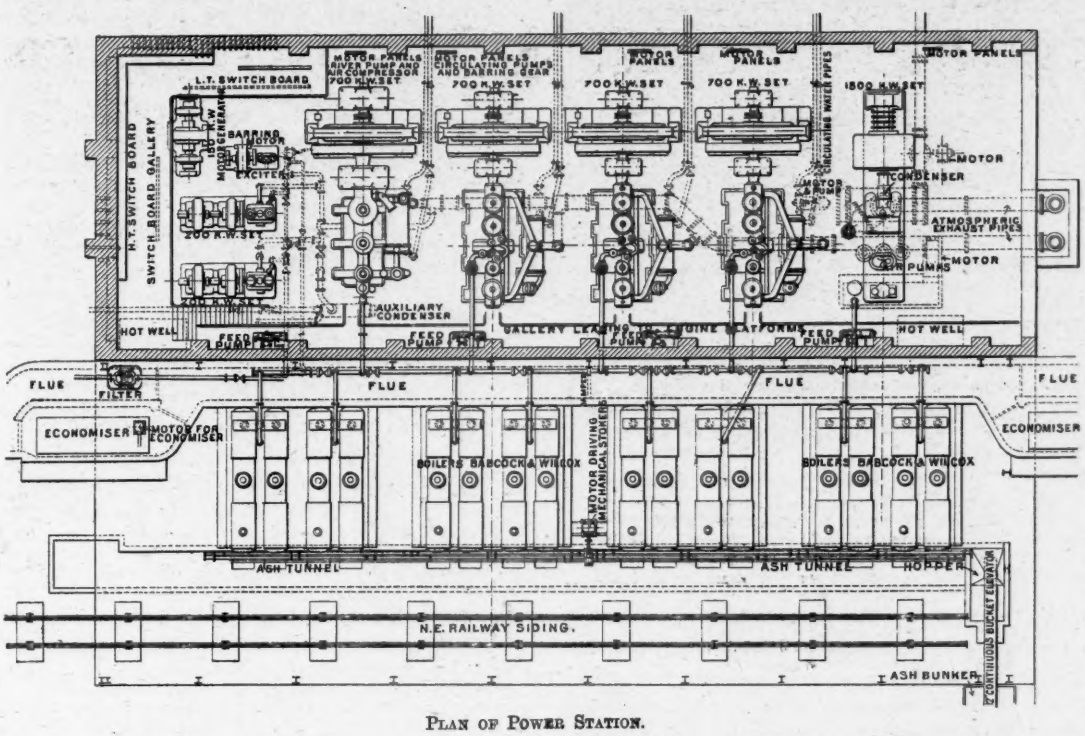
The three-phase machines have the centres of their star windings connected to earth by means of an insulated cable, running to the main earth plates. Most of the iron work in the engine room is earthed through a copper strip running the whole length of the building. Woodwork is avoided entirely, thereby minimising the risk of fire.

Exterior of Power Station, Neptune Bank.

A motor-driven air compressor is placed in the cable basement, from which compressed air is supplied through pipes for cleaning high pressure switch gear and armatures.

Equipment. — The plant in this power station will eventually consist of: — Eight Babcock & Wilcox boilers; two 300-B.H.P. Belliss engines, each driving two

100-kw. 240-volt D.C. generators; one 75-b.h.p. Belliss engine, driving one 50-kw. 240-volt D.C. generator; four 1,400-i.h.p. triple-expansion engines, each driving a 700-kw. 5,500-volt three-phase alternator; one 1,500-kw. Parsons



Plan of Power Station.

turbo-alternator, 5,500 volts three-phase; one 150-kw. 5,500 to 240 volts three-phase continuous current synchronous motor-generator.

(*To be continued.*)

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 18.)

Telegraphic Interruptions and Repairs :—

	Cables.	Interrupted.	Repaired.
Latakia-Cyprus	.. ..	June 20, 1899 ..	..
Para-Maranham	.. ..	March 1, 1900 ..	..
Landlines :—			
Bolama-Bissao	.. ..	May 19, 1901 ..	June 26th
Cayenne-Pinheiro	.. ..	April 20, 1901 ..	..
Pekin-Kalgan	.. ..	June 14, 1900 ..	..
Maimatchin-Kalgan	.. ..	June 30, 1900 ..	..

Lord Londonderry and the Postal Service.—Lord Londonderry has issued a lengthy rejoinder to the charge of "breach of faith," brought against the Postal Administration by the London telegraph staff. The reply, which is dated June 27th, 1901, says, "The Postmaster-General has had before him an application for an interview made on behalf of the London Branch of the Postal Telegraph Clerks' Association, with regard to certain passages in a letter addressed to Sir A. Rollit by his lordship's direction on April 25th last. The views expressed in the letter were the result of careful consideration by the Postmaster-General, and he can hold out no hope of finding himself able to depart from them; but if the applicants still desire to have a personal interview, he will be happy to receive them. As, however, they appear to be labouring under some misapprehension on the subject in question, the Postmaster-General thinks it desirable, before seeing them personally, to make the following further observations:—It is the case that the regulations issued by the Civil Service Commissioners for the competitive examinations held between November, 1881, and December, 1889, contained a note to the effect that successful candidates have a 'prospect of attaining £190 a year.' This note was withdrawn after the examination held in December, 1889. The contention appears to be that this note constitutes a contract or 'promise' that those who entered the service through the examinations in question would, in the ordinary course, reach a salary of £190. The Postmaster-General regrets that he is wholly unable to admit this contention. The words did not in fact constitute either a contract or a promise of any kind. They simply indicated the salary which it was possible for a successful candidate to attain under the conditions existing at the time when the notice was issued. They did not pledge the Postmaster-General and his successors either to maintain those conditions permanently or to secure a salary of £190 to any particular candidate at any time during his career. The conditions under which a salary of £190 could be attained were not set out in detail but every candidate must have been aware that the prospect of attaining that salary was not unconditional, but depended *inter alia* upon the occurrence of vacancies in the classes above him, and on his being found duly qualified for promotion. It was within the competence of the Postmaster-General or his successors to vary those conditions as the interests of the public service might from time to time require, and more particularly to prescribe the qualifications which should from time to time entitle an officer to promotion from class to class. The prospect of £190 is still open to all who entered the service with that inducement before them, and the conditions under which it is attained do not materially differ from those that prevailed at any time between 1881 and 1889. . . . Both the rate of promotion and the qualifications required may have varied from time to time, and it is possible that some who were not fully qualified have been advanced. But the Postmaster-General cannot admit that this affords any ground of complaint on the part of officers who have failed to obtain promotion, or whose turn has not yet come. Even if the original note had stated that any particular standard of qualification was required, the Postmaster-General holds that it was within his discretion and the discretion of his predecessors either to raise or lower the standard or to vary the duties as the interests of the public service might require. Nothing, however, was said on this point, and there is, therefore, the less ground for any grievance in consequence of variations which may, in the course of time, have been introduced." This enunciation of the absolute discretion of the Postmaster-General is followed by the statement that the number of men entering under this promise was 530, but that as there are others awaiting promotion who entered prior to 1881, there is as yet no ground for grievance even if the contentions are admitted. The Tweedmouth Committee, Lord Londonderry says, thought £160 adequate remuneration for the general body. "Any alteration which has been made since 1881 in the qualifications required for promotion to the senior class was carried out long before the Tweedmouth Committee reported, and their report was made in view of the facts which they found existing at the time. . . . . The Postmaster-General has dealt with the question at some length because he was anxious to satisfy both himself and the staff that the charge brought against his predecessors of a 'breach of faith' was wholly without foundation; and unless new facts of which he is unaware can be brought forward, he sees no likelihood of coming to any other conclusion than that which he has expressed above"; he is, however, willing to receive a deputation.

The London branch of the Postal Telegraph Clerks' Association has addressed a note to the Postmaster-General, accepting his offer to receive a deputation to discuss the question of a "breach of faith," and has asked Lord Londonderry to appoint an early date for the interview.

Telephone Patents.—The *Electrical World*, of New York, says that a decision was rendered on June 7th in favour of the Western Electric Company, in the United States Circuit Court of the Eastern District of Missouri, on Patent No. 438,788, and that in

the same Court a decision was rendered upholding the Seely patent on the employment of answering spring-jacks in multiple switchboards. Both of these suits were brought by the Western Electric Company against the Kinloch Telephone Company, of St. Louis. The apparatus found to infringe Patent No. 438,788, is the carbon plate protector, manufactured by the Sterling Electric Company. The apparatus found to infringe the Seely answering jack patent is the multiple switchboard built by the Kellogg Switchboard and Supply Company, of Chicago.

CONTRACTS OPEN AND CLOSED.

OPEN

Amsterdam.—September 2nd. H.M. Consul at Amsterdam states that tenders are invited by the Municipality of Amsterdam for the supply of "electrical tram-carriages arranged for above-ground supply of electricity, and for about 5,000 tons of grooved rails for tramways, with necessary appurtenances." Particulars may be obtained from the Director of the Municipal Tramways, Nieuwe Achtergracht, No. 164, Amsterdam.

Birkenhead.—July 16th. The Corporation wants tenders for 15 electric car bodies, also equipments, trucks and trolleys. See "Official Notices" June 21st.

Brazil.—July 8th. The Foreign Secretary has received a despatch from H.M. Consul-General at Rio de Janeiro, stating that tenders are invited by the Brazilian Government, to be received not later than July 8th, for the supply of electrical machinery for the hoisting and transporting of locomotives at the Engenho de Dentro Works. Some particulars may be examined at the Commercial Department of the Foreign Office.

Brecon.—August 5th. Tenders are invited for electrically lighting the Brecon and Radnor Joint Asylum now erecting at Talgarth. See "Official Notices" June 28th.

Cleckheaton.—July 13th. The Council wants tenders for Lancashire boilers, economiser, condenser, pumps, Meldrum's furnaces, balancers and boosters, battery, cables, switchboards and travelling crane. See "Official Notices" June 28th.

Colne.—July 5th. The Technical Committee wants tenders for a 6 B.H.P. "protected" motor, &c. See "Official Notices" June 28th.

Darlington.—July 16th. "Free" or "assisted" wiring proposals are wanted by the E.L. Committee. See "Official Notices" June 21st.

Dartford.—July 24th. The Council wants tenders for D.C. meters and cut-outs. See "Official Notices" to-day.

Dudley.—July 6th. The E. L. and T. Committee wants tenders for a steam engine and dynamo. See "Official Notices" June 21st.

France.—July 18th. Tenders are being invited until the 18th inst. by the French Post and Telegraph authorities in Paris for the supply of 280 tons of copper wire. Tenders are to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, Paris, whence particulars may be obtained.

France.—The municipal authorities of Ardres, a small town in the vicinity of Calais, are inviting tenders for the concession for the electric lighting of the town. Further particulars may be obtained by addressing La Mairie d'Ardres, Pas de Calais, France.

Greenock.—July 17th. The Police Board wants tenders for surface condenser, &c., and fan for induced draught. See "Official Notices" to-day

Kirkcaldy.—July 20th. The Corporation wants tenders for feeders, mains, road work, and arc lamps. See "Official Notices" June 28th.

London.—July 23rd. The L.C.C. wants tenders for boilers, pumps, cooking apparatus, and electric lighting installation (exclusive of generating plant) for Horton Asylum. See "Official Notices" to-day.

Mansfield.—July 12th. The Corporation wants tenders for Lancashire boilers, stokers, pumps, economiser, 200-K.W. steam generators, motor transformers, condensing plant, switchboard, battery, crane, mains, arc lighting, meters, and workshop equipment. See "Official Notices" June 7th.

Pontypridd.—July 23rd. The Guardians want tenders for electric lighting at the Union Workhouse, Infirmary, and other buildings. Particulars from, and tenders to, Mr. W. Speckett, Clerk, Union Offices.

Shoreditch.—July 10th. The Borough Council wants tenders for switchboards and instruments for its stations and sub-stations. See "Official Notices" June 28th.

Southwark.—July 10th. The E.L. Committee wants tenders for two new panels for the main switchboard. See "Official Notices" June 28th.

Spain.—July 9th. Tenders are being invited until July 9th, by the Municipal authorities of Riaza (Segoria province), for the concession for the electric lighting of the town during a period of 20 years. Tenders to be sent to El Secretario del Ayuntamiento de Riaza (Segoria), whence particulars may be obtained.

Spain.—July 26th. The Spanish Ministry of Industry and Public Works in Madrid are inviting tenders until the 26th inst., for the construction and working of an electric tramway between El Santuario de la Yedra and the station at Balza (province of Jaen.) Particulars may be obtained from, and tenders are to be sent to, El Ministerio de Agricultura, Industria, and Obras Publicas, Madrid.

Spain.—The municipal authorities of Pedreguer (province of Alicante), have just invited tenders for the concession for the electric lighting of the town during a period of 15 years.

St. Pancras.—July 11th. The Council wants tenders for three-phase motors coupled to C.C. generators, with switchboard, &c.; also three-core lead-covered high pressure cables. See "Official Notices" to-day.

Stepney.—July 18th. The Borough Council wants tenders of steam and other pipe works, paper cables, conduits, &c. See "Official Notices" June 28th.

CLOSED.

Belgium.—The Belgian State Railway authorities in Brussels last week opened tenders for the supply and erection of two shunt-wound 30-K.W. dynamos with pulleys, rheostats, &c, for a power station about to be established at Jamet, Brulotte. 11 Belgium, one French, and two German firms competed for the order, the lowest tender being that of the Compagnie Belge d'Electricite, of Brussels, who quoted 6,837½ francs. The quotations ranged from this up to as high as 12,468 francs.

Dundee.—Messrs. Aiton & Co., of Willesden Junction, have been awarded the contract for pipework at the Municipal Electricity Works.

London.—The Shoreditch Borough Council have accepted the tender of the General Electric Company, which was the lowest, for the supply of carbons during the ensuing year. The other firms who tendered were the Sloan Electrical Company, Crompton & Co., the Brockie-Pell Company, and Messrs. Johnson and Phillips.

West Ham.—The *Contract Journal* publishes the following list of tenders submitted for the supply of electric tramway machinery, &c., for the T.C.:—

TRAMWAY MACHINERY.

Ferranti	£12,700
Verity & Co.	13,908
General Electric Company	13,700
Brush Electrical Company	12,270
Witting Bros.	11,790
J. Fowler & Co.	12 855
Siemens Bros.	12,774
Thames Ironworks Company	13,200
Scott & Mountain	14,598
Cole, Marchent & Morley	20,577
J. & H. Maclaren	18,002
Mather & Platt	12,530
Johnson-Lundell Electric Traction Company	12,084
British Schuckert Company	12,349
British Westinghouse Company	14,433
Parsons	11,829
F. Suter & Co.	12,180
Bergtheil & Young	13,597
V. Coates & Co.	22,000
Lancashire Motor and Dynamo Company	13,407
Lancashire Motor and Dynamo Company (alternative)	13,425
Lancashire Motor and Dynamo Company (alternative)	14,318
International Engineering Company	11,710
Dick, Kerr & Co.	17,750
Allgemeine Elektricitäts-Gesellschaft, Berlin	10,840
Allgemeine Elektricitäts-Gesellschaft (alternative)	8,926

Engineer's estimate, £25,000.

ELEVEN WATER-TUBE BOILERS AND FITTINGS.

J. Thompson, Wolverhampton	16,250
Babcock & Wilcox	14,720
R. Hornsby & Sons	13,791
Stirling Boiler Company	15,214
Rowland & Co.	17,520

Engineer's estimate, £18,000.

The tenders have been referred to committee.

FORTHCOMING EVENTS.

Saturday, July 13th.—At 3 p.m. Institution of Junior Engineers. Visit to the Millwall Lead Works.

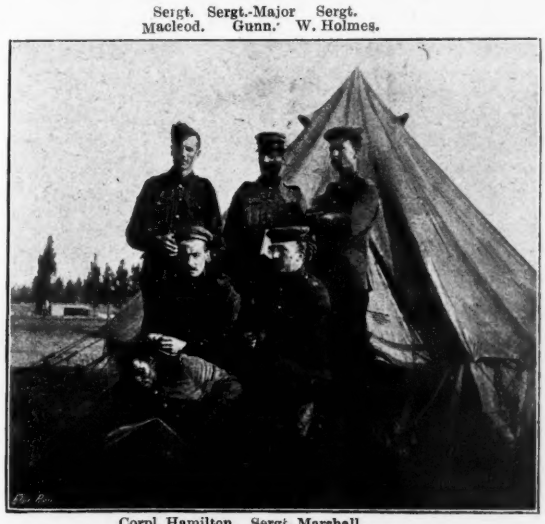
Lightning Fatalities.—It is reported that 11 out of 12 members of a fishing party on Lake Michigan were killed by lightning this week when taking refuge under a pier. Their bodies were twisted into fantastic shapes by the lightning.

NOTES.

Why the Belleville Boiler Failed.—Opening a daily paper a few days ago, we stumbled across an explanation of the reason for the failure of the Belleville boiler that was as grotesque as can well be imagined. This reason was that certain packings that ought to have been used were not employed, and the inference was, of course, that given the proper packing, all would be well. We are, in fact, invited to believe that the change of a packing is going to make a success of a boiler that is not constructed upon principles that will ensure it. At the same time there is a big noise being made about certain trials of the *Minerva* and the *Hyacinth*. We are asked to believe that these trials have shown the superiority of the Belleville. Nothing we have ever written on the Belleville boiler has been one-half so strong as what has been told us by those in a position to know the facts. We have not condemned the water-tube principle. We condemn the principle adopted in the Navy, and once again we enter our protest against the fresh attempts to bolster up the Belleville.

The Electrical Volunteers in South Africa.—From a correspondent who is with the Electrical Volunteers in Johannesburg, we have received the following news of the movements of the corps:—"Perhaps you will be glad to know what the E.Es. are doing now in the sunny south, as you took such a great interest in the former detachment. Well, after an interesting, but uncomfortable and lengthy train journey up country, we arrived at Norvals Pont, and stuck fast for want of loco. engines. Here we left a portion of "B" Company under Capt. Craven. Continuing our journey and travelling by day only, we reached Elandsfontein. At Vereeniging the remainder of "B" Company under Lieut. Leaf detrained. "A" company came on to Johannesburg

Sergt. Macleod. Sergt.-Major Gunn. Sergt. W. Holmes.



Corpl. Hamilton. Sergt. Marshall. Zebulon ("our boy").

and settled down under canvas in the Police Barracks just outside the Fort. The officers now occupy a house, and we also have a house for our stores and Sergeants' quarters. "A" Company is split up into several detachments at Klerksdorp, Krugersdorp, Springs, No. 13 General Hospital, and parties working from here, all on lighting or searchlight work. The Norvals Pont party have since come up to Bloemfontein. I miss the ELECTRICAL REVIEW somewhat; it seems quite strange to get no news, but we have very little time for recreation. I am glad to say we have had very little sickness, and all enjoy the work. I enclose a photo. of the Sergt.-Major and Section commanders taken outside our tent."

The following official notes will show the occupations upon which the men are now engaged :—

The Headquarters are at Johannesburg. "A" Company have taken over all the electrical work in the Transvaal south of Pretoria, "B" Company are looking after the work in the Orange River Colony.

The following shows the general distribution of the two Companies; the names are given where known :—

Major A. Bain, Captain J. J. F. O'Shaughnessy, 2nd Lieutenant T. Rich, Johannesburg; Captain the Hon. R. C. Craven, Bloemfontein; Lieut. E. H. Leaf, Vereeniging; Lieut. J. E. Pearce, near Johannesburg.

C.-S.-M. J. H. Field and four men at Simons Town; No. 1 Section, "B" Company, at Bloemfontein; No. 2 Section, "B" Company, at Vereeniging; three men (2nd Corporal Pepper, Sappers Thomas and Venables) on armoured train running between Bloemfontein and Pretoria.

"A" Company. One N.C.O. and two men (2nd Corporal Bell, Sappers Balgley and Peck) running searchlights at Springs; Corporal Rogers and two men running searchlights at Krugersdorp; two men running searchlights at Randfontein; two men running searchlights at Forest Hill; four men (Corporal Shaw and three Sappers) running searchlights at Klerksdorp.

One Officer and 14 men erecting steam plant and running lights at No. 13 General Hospital at Henry Nourse Mine, near Elandsfontein; one man in charge of lights at No. 6 Hospital, Johannesburg; two men running lights at Crown Reef Mine.

The entire lighting up, including laying down and fitting plant, of the Fort at Klerksdorp, to be taken over shortly. No. 13 Hospital and Forest Hill lights were entirely erected by our own men, and the later work was done in record time.

Three men are in hospital, but are all recovering, and are probably back at duty before this.

C. T. RUSE,
Acting Sergeant-Major.

HEADQUARTERS.

Improvements in the Holy Land.—It has often been stated that if one of the Prophets had returned to the field of his labours, he would have had little difficulty in recognising the whole scene, but to-day matters are decidedly changed. The railway from Joppa to Jerusalem is now on a paying basis, and other lines which will connect it with points of interest up and down the valley of the Jordan have been projected or are actually in course of building. In Jerusalem there are electric lights, telephones, phonographs, modern stores and sanitary plumbing; in fact, all the comforts of civilised life can now be obtained. Trolley lines are projected to connect Jerusalem with Bethany, Bethlehem, the Lake of Galilee, Samaria, Jericho, Nazareth and other places. Recently an American salesman went to Jerusalem and Beirut, and sold modern merchandise to the amount of $3,800. More than 200 phonographs were recently sent to Jerusalem, Damascus and nearby places, the Moslems buying them largely for their harems. There seems to be a considerable opening for windmills and irrigating machinery in the East. The Sultan appears to be favourably disposed toward the modernising of this part of his dominions.—*Scientific American.*

The Verband Deutscher Electrotechniker.—The ninth annual meeting of the Verband Deutscher Electrotechniker was held in Dresden from the 27th to the 30th ult. A number of papers were read, including one by Herr M. Schiemann on "Electric Express Railways," one by Herr Prof. Heim on "A Method of Increasing the Capacity of Accumulators," one by Prof. Teussner on "The Weissmann Lighting System," and one by Herr Meng on "The Dresden West Municipal Power Stations." Visits were also paid to a number of works and places of interest in the district.

Weather Forecasts by Wireless Telegraphy.—Tammasina, the Italian scientist, has adapted the receiving apparatus used in wireless telegraphy of the Marconi type to follow the course of distant thunderstorms, and even to forecast rainy weather 12 hours in advance. The apparatus consists essentially of a coherer with its vertical wire, an electro-magnet, a dry cell, and a telephone. Experiments were carried out at Geneva with this apparatus which was fully described before the Paris Academy of Sciences. When a storm was passing over, discharges were indicated by an electric bell, the strength or distance of the discharge being indicated by the vigour of the stroke of the bell. When the weather changed without a thunderstorm, a peculiar crackling was always heard in the telephone, and rain could be predicted by this means with great certainty 12 hours in advance. Tammasina considers that his apparatus would be of great use on ships at sea for predicting storms, and he is of opinion that it is much more reliable than the present instruments used for predicting the weather.

With the Institution of Electrical Engineers in Germany.—A dinner was given on Tuesday evening last week to a small and select company by Dr. Aron, Lieut.-Col. R. E. Crompton, and Mr. H. Hirst, directors of the Aron Electricity Meter Company. A sumptious repast was provided, and a most pleasant evening was spent. On Wednesday the visitors were shown round by the A.E.G.; starting from Berlin by steamer, they enjoyed a pleasant voyage to the cable works of the A.E.G. at Oberspree, being received by a guard of honour composed of the works fire brigade, with a martial salute of detonators arranged along the bank. The inspection of these fine works was followed by an interesting display of high-voltage experiments, and an excellent lunch. After a most hearty farewell, the party set out in the steamer for Treptow, walked through the electric railway tunnel under the Spree, and entrained for the dynamo works of the A.E.G. and their apparatus works, both of which were inspected with the keenest interest. In the evening Messrs. Siemens & Halske and the A.E.G. jointly gave a dinner at the Zoological Gardens, at which the lavish hospitality of our German hosts reached its culminating point.

On Thursday about 100 of the visitors inspected the Berlin Elevated Railway, which is being constructed by Messrs. Siemens & Halske, together with the power station by which it is to be operated. In the afternoon a number of members of the party left for Dresden, while the remainder inspected the tool works of Messrs. Ludwig Loewe, and the dynamo works of the Union Electricitäts Gesellschaft; a small number visited the Technical High School, where they were courteously received by Prof. Slaby.

On Friday a large number of the members departed for London, while others visited the German Niles Tool Company's works. This concluded the Berlin visit; those members of the party who did not return to London proceeded to join their *confrères* at Dresden, who on the same day attended an introductory meeting of the Verband Deutscher Elektrotechniker, and visited the City Light and Power works and the State Heat-transmission works. In the evening the visitors dined with the German Society.

On Saturday the meeting of the Verband was continued; in the afternoon the railway works and repair shops were visited, and in the evening the visitors attended a garden party, which terminated in an informal dance.

Sunday was given up to recreation, the principal event being a most enjoyable visit to "Saxon Switzerland" with the Verband, in which most of the party took part. On Monday a number of the visitors left for London; the remainder for Nüremberg, where on Tuesday they visited the magnificent establishments of Messrs. Schuckert & Co., employing over 6,000 hands. In the evening they were most hospitably entertained to dinner by the company, some of the party first paying a visit to the city electricity works.

Foreign v. English Machines at Manchester.—Replying to a question at the meeting of the Manchester Corporation on Wednesday, as to why the contract for electrical machinery at the Stuart Street station had been given to a foreign firm instead of an English one, Dr. Bishop, chairman of the Electricity Committee, said that it might be supposed, from what had appeared in the newspapers, that a great many English firms had offered to make the machinery, but of the 18 firms which offered to make the motor-generators, 15 of them contracted on the understanding that they should be made abroad. Only one of the two firms which would have made the motors in England could supply them with the engines they wanted, and this firm's tender was £26,000 larger than that of the successful firm. The proceedings of the Committee were adopted.

Calculation of Fly-wheel Effect.—It may be well to point out that some slips occur in Mr. Meyer's article on pp. 6 and 7. In the first place, s is not the percentage, as stated in several places, but the fractional variation of speed. Again, at the foot of p. 6, for "weight of fly-wheel" we should evidently read "change of energy," while $v_2 = v_0\left(1+\frac{s}{2}\right)$, and so on, not as written. In the second column there is no occasion for introducing a correcting factor for the radius of the fly-wheel, seeing that the linear velocity of the rim has been used all along; but, in any case, the factor, as given, is inverted. These errors do not, however, affect the results given by the author.

At Glasgow in September.—Mr. Andrew Jamieson will read a paper at the Glasgow International Engineering Congress on the "Protection of Trolley Wires." Prof. Magnus Maclean, D.Sc., is to read a paper on "Kelvin's Electric Measuring Instruments."

Appointment Vacant.—A resident electrical engineer at £300 per annum is wanted for Swansea.

Liquidations.—As we go to press the following letter comes to hand from the Premier Electric Lamp Company, Limited:—

In your issue of the 28th ult. we notice you announce a final liquidation meeting of the Premier Electric Lamp Syndicate. As this is causing some confusion in the minds of some of our customers, we shall feel obliged if you will insert in your next issue a notice to the effect that the liquidation refers to the pioneer syndicate, and not to this company.

Marriages.—At Monkwearmouth Parish Church on 18th ult., Mr. Thomas W. Dunning, chief electrical engineer at Melton Mowbray, was married to Miss L. M. Duncan, of Monkwearmouth.

Mr. Leigh Robinson, son of Prof. Henry Robinson, was married on June 26th to Miss Agnes Kate Witt, of King's Lynn.

NEW COMPANIES REGISTERED.

Hiram Maxim Lamp Company, Limited (70,503).—This company was registered on June 17th, with a capital of £70,000 in £1 shares, to adopt an agreement with C. M. Downie to carry on the business of electricians, mechanical engineers, producers and suppliers of electricity for the purposes of light, heat or power, and manufacturers of and dealers in all apparatus and things required for and capable of being used in connection with the generation, distribution, supply, accumulation, and employment of electricity, and for the purposes of the company to erect and maintain any shops, stores, warehouses or other conveniences. The first subscribers (each with one share) are:—C. V. de Falbe, 104, Sternhold Avenue, S.W., electrical engineer; L. A. S. Wood, 20, Livingstone Mansions, West Kensington, electrical engineer: C. M. Downie, 44, Gillingham Street, S.W., electrical engineer; F. Stokes, 50, Bishopsgate Street, E.C., merchant; G. W. Nagle, 26, Stoke Newington Road, N.E., clerk; T. B. Brown, 167, Grosvenor Road, S.W., clerk; and W. W. Jordan, Russell House, Birkbeck Road, Enfield, Middlesex, cashier. Minimum subscription, 10 per cent. of the shares offered to the public. The number of directors is not to be less than three nor more than seven. The first are C. V. de Falbe, L. A. S. Wood, C. M. Downie, F. Stokes, G. W. Nagle, F. B. Brown, W. W. Jordan; subsequent directors to be appointed by them. Qualification, one share; remuneration, £150 each per annum (£250 for the chairman).

South American Syndicate, Limited (70,519).—This company was registered on June 17th, with a capital of £1,500 in £1 shares, to acquire real or personal property in South America or elsewhere, to acquire and operate any systems of tramways, railways, or light railways in South America, and to carry on the business of an electric light company, and of electricians, mechanical engineers, bankers, financiers, &c. The first subscribers (each with one share) are:—H. E. Warner, 10, Finsbury Circus, E.C., solicitor; A. Balderson, 27, Crofton Park Road, Brockley, S.E., cashier; G. Swainsel, 10, Finsbury Circus, E.C., solicitor; H. W. Prestoe, 4, Boscombe Road, Shepherd's Bush, W., clerk; A. E. Rodick, 54, Westbourne Road, Forest Hill, clerk; A. Tempest, 1, Mallock Villa, Hoe Street, Walthamstow, clerk; A. Constable, 144, Victoria Street, London, S.W., clerk. No initial public issue. The number of directors is not to be less than two nor more than four; the subscribers are to appoint the first; remuneration as fixed by the company. Registered office, 17, Coleman Street, E.C.

Warren, Beattie & Co., Limited (70,585).—This company was registered on June 22nd, with a capital of £10,000 in £5 shares, to take over the business of electrical engineers and contractors carried on by J. W. F. Warren and J. Beattie, at Middlesbrough, as "Warren, Beattie & Co.," and to carry on the business of electricians, mechanical and electrical engineers, manufacturers of electrical apparatus and appliances, suppliers of light and powers, &c. The first subscribers are:—J. W. F. Warren, Commercial Street, Middlesbrough, electrical engineer, with 40 shares; Joseph Beattie, Commercial Street, Middlesbrough, electrical engineer, with 40 shares; C. Bertram, Commercial Street, Middlesbrough, electrical engineer, with 40 shares; S. N. Warren, Commercial Street, Middlesbrough, electrical engineer, with 40 shares; Mrs. K. Warren, Linthorpe, Middlesbrough, with 1 share; A. H. France, Post Office, Grangetown, Yorks, book-keeper, with 1 share; and John Beattie, J.P., 5, Summerhill Grove, Newcastle-on-Tyne, director, with 40 shares. No initial public issue. The number of directors is not to be less than three nor more than seven. The first are H. W. F.

Warren, Joseph Beattie, C. Bertram, S. N. Warren and John Beattie, J.P. Qualification, £200; remuneration as fixed by the company.

Metals Corporation, Limited (70,569).—This company was registered on June 21st, with a capital of £25,000 in £1 shares, to adopt an agreement with the Electrical Corporation, Limited, for the acquisition of the benefit of certain inventions and letters patent in relation to the electro-deposition of metals, the manufacture of tubes or sheets of copper or other metals, and the manufacture of copper wire or strip, and to carry on the business of metal workers and merchants generally, and for the above purposes to erect and maintain any machinery, buildings, &c. The first subscribers (each with one share) are:—A. Richardson, Finsbury House, E.C., solicitor; T. C. Cleary, 206, Albion Street, Stoke Newington, N., gentleman; W. Webb, 39, New Broad Street, E.C., solicitor; P. Williams, 59A, Haverill Road, Balham, solicitor's clerk; W. Bowles, 101, Raleigh Road, Hornsey, clerk; C. J. Bridge, 24, St. Paul's Road, Canonbury, gentleman; and R. H. Webb, 39, New Broad Street, E.C., solicitor. Minimum cash subscription, 2,000 shares. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, 100 shares; remuneration, £200 per annum, divisible (£10 extra for the chairman).

A. G. Beaver & Co., Limited (70,513).—This company was registered on June 17th, with a capital of £6,000 in £1 shares, to acquire the business carried on by W. E. Sotheby, at 151 to 157, Wardour Street, W., as "A. G. Beaver & Co.," to generate, produce, store, accumulate and distribute electricity, electromotive force or other similar agency for the purpose of lighting streets, public places, buildings, factories, mines, lighthouses, railways, tramways and other places or things, or for plating, combining, separating or otherwise working in metals, or for carrying out or facilitating any mechanical operations or for any other purpose, and to carry on the business of electricians, mechanical engineers, manufacturers of electrical apparatus, metals, insulators, conductors, phonographs, bells and other articles. The first subscribers (each with one share) are:—G. J. G. Lothian, Albion Chambers, Westminster, S.W., electrical engineer; H. P. C. Kelland, 53, Victoria Street, S.W., chartered accountant; F. J. Pearce, 719, Barking Road, Plaistow, clerk; H. F. Birch, 61, Parson's Green Lane, S.W., accountant; E. C. de Segundo, 28, Victoria Street, S.W., consulting engineer; H. J. Jack, Bridgwater, Somerset, manager; and T. N. Manks, 102, Drayton Park, N., mining engineer. Minimum cash subscription, £1,000. The first directors are G. L. Nicholson, H. P. C. Kelland and E. C. de Segundo, all of whom may act without qualification; qualification of other directors, £100.

L'Auto-Regulateur Moteur Hydraulique "Cassel," Limited (70,546).—This company was registered on June 20th, with a capital of £15,000 in £1 shares, to adopt an agreement with E. F. Cassel, and to carry on the business of ironfounders, marine, hydraulic, mechanical, civil, consulting and electrical engineers, agricultural implement makers, founders, machinists, makers of rolling stock, tool makers, hardwaremen, &c. The first subscribers (each with one share) are:—C. K. King, Purbrook, Dorking, gentleman; E. F. Cassel, 56, Broad Street Avenue, E.C., hydraulic engineer; S. J. Souter-Robertson, 66, Holland Road, W., gentleman; H. F. Hirch, 61, Parson's Green Lane, S.W., accountant; W. E. Sotheby, 28, Victoria Street, S.W., electrical engineer; T. J. S. Jones, 4, Copthall Chambers, E.C., stockbroker; and F. J. D. Siddell, Churchgate, Cheshunt, gentleman. No initial public issue. The number of directors is not to be less than two nor more than seven; the first are E. F. Cassel, E. W. Serrell, jun., O. Servan, and E. C. de Segundo; qualification, £250 shares; remuneration, 5 per cent. of the net profits, divisible; registered office, 56, Broad Street House, E.C.

Chepstow Electric Lighting and Power Company, Limited (70,646).—This company was registered on June 27th, with a capital of £2,000 in £1 shares, to carry on at Chepstow and elsewhere the business of an electric lighting and power company in all its branches and the general business of electricians, engineers, and suppliers of electricity. The first subscribers are:—C. O. Liddell, Larkfield, Chepstow, gentleman, 50 shares; S. W. Yockney, Wye Cottage, Tidenham, Glos., civil engineer, 50 shares; T. V. Ellis, Oakcliffe, Chepstow, gentleman, 50 shares; J. Rowe, Chepstow, civil engineer, 50 shares; G. C. Francis, Chepstow, solicitor, 50 shares; W. S. Jones, Castleford, Chepstow, gentleman, 50 shares; and W. A. Shoolbred, St. Ann's, Chepstow, surgeon, 25 shares. Minimum cash subscription, one-third of the shares first offered to the public. The number of directors is not to be less than three nor more than seven; the first are C. O. Liddell, S. W. Yockney, T. V. Ellis, G. C. Francis, and W. S. Jones; qualification, £50; remuneration as fixed by the company.

Leatherhead and District Electricity Company, Limited (70,637).—This company was registered on June 26th, with a capital of £10,000 in £1 shares, to acquire from the Urban District Council of Leatherhead the transfer of and all benefit and rights under the Leatherhead Electric Lighting Order, 1898, to carry out the work authorised by such order or to acquire and carry out any similar or extended order, to carry on the business of an electric lighting company and to produce and supply electricity. The first subscribers (each with one share) are:—N. Davy, 23, Garrick Street, W.C., printer; A. Hammond, 24, Cornwall Road, Stroud Green, N., stationer; J. B. Yarrow, 239, West Green Road, South Tottenham, clerk; F. Airris, 12, Muschamp Road, S.E., clerk; J. K. White, 4, Eastcheap, E.C., solicitor; A. A. Strong, 4, Eastcheap, E.C., solicitor; and C. E. Brady, 2, Hawthorn Villas, High Road, Wealdstone, clerk. No initial public issue. The number of directors is not to be less than two nor more than five; the first are to be appointed by the subscribers. Remuneration as fixed by the company. Registered office, 3, Arundel Street, Strand, W.C.

West Riding Tramways and Electricity Supply Company, Limited (70,670).—This company was registered on June 28th, with a capital of £275,000 in £1 shares (125,000 preference), to acquire any tramways or light railways within the urban districts of Castleford, Featherstone, Normanton, Whitwood and Knottingley, the town and rural district of Pontefract, and the rural district of Tadcaster, all in the West Riding of Yorkshire, or in any adjoining districts or elsewhere in England, to apply for any necessary orders, Acts of Parliament and authorities, to adopt an agreement with the United Kingdom Tramway, Light Railway and Electrical Syndicate, Limited, to equip, maintain and work by electricity or by steam, oil, horse or other power all tramways and light railways belonging to the company, and to carry on the business of tramway, railway, light railway, omnibus and van proprietors, carriers, constructors and makers of tramways, railways, light railways, rolling stock, accumulators, dynamos, apparatus and conveniences, suppliers of electricity, electrical and general engineers, metallurgists, contractors, financiers, &c. The first subscribers (each with one ordinary share) are:—R. L. York, 39, Lofthouse Place, Leeds, engineer; R. J. Longley, 13, Clarendon Place, Leeds, civil engineer; H. Courtney, 412, Eccles New Road, Weast, Manchester, land surveyor; W. Spinks, 20, Park Road, Leeds, civil engineer; E. F. Chapman, 76A, Harehills Avenue, Leeds, gas engineer; L. W. Stanley, 90, Harehills Avenue, Leeds, consulting chemist; and S. H. Cook, 3, Arundel Street, Strand, W.C., clerk. Minimum cash subscription 10 per cent. of any shares first offered to the public. The number of directors is not to be less than five nor more than seven; the first are to be appointed by the subscribers. Qualification, £250; remuneration as fixed by the company.

Lodge-Muirhead Wireless and General Telegraphy Syndicate, Limited (70,681).—This company was registered on June 29th, with a capital of £50,000 in £1 shares, to acquire any patents, licences, concessions, or inventions relating to telegraphy, telephony and the like, and in particular to acquire from Oliver J. Lodge, F.R.S., and A. Muirhead, D.Sc., the benefit of certain existing inventions relating to telegraphy and telephony, and to carry on the business of telegraph, mechanical and electrical engineers and contractors, manufacturers of dynamos and telegraphic works, instruments, wires, cables, insulators and electrical fittings and apparatus, launch and shipbuilders, wire drawers, tube makers, smiths, metallurgists, founders, &c. The first subscribers (each with one share) are:—Oliver J. Lodge, F.R.S., The University, Birmingham, principal; Alexander Muirhead, D.Sc., 54, Old Broad Street, E.C., electrical engineer; Henry J. Muirhead, 54, Old Broad Street, E.C., stockbroker; F. Lauder Muirhead, Downe, Kent, electrical engineer; G. J. Bayspool Porter, 2, Wardrobe Place, Doctors' Commons, solicitor; William Russell, 2, Wardrobe Place, Doctors' Commons, solicitor; and Cecil S. Goule, 105, Gloucester Road, Regent's Park, solicitor. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are Alexander Muirhead, Henry J. Muirhead, and F. Lauder Muirhead; qualification, £253; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Newcastle-upon-Tyne Electric Supply Company, Limited (27,997).—This company's annual return was filed on March 20th, when 23,750 preference and 18,739 ordinary shares were taken up out of a nominal capital of £300,000 in £5 shares (30,000 preference). £2 per share has been called up on 20,000 preference, and £5 per share on 17,922 ordinary shares, resulting in the receipt of £129,610, in addition to which £12,261 10s. has been paid in advance of calls. £22,835 is considered as paid on 3,750 preference and 817 ordinary shares. No mortgages or charges.

Windsor Electrical Installation Company, Limited (46,186).—This company's annual return was filed on April 24th, when the entire capital of £50,000 in £1 shares had been taken up. £1 per share has been called up on 49,500, and nothing on 50 shares, resulting in the receipt of £49,500. 450 shares are considered as fully paid. No mortgages or charges.

Oriental Telephone and Electric Company, Limited (48,691).—This company's annual return was filed on May 17th, when 171,504 shares were taken up out of a nominal capital of £200,000 in £1 shares. £1 per share has been called up on seven, resulting in the receipt of £7. £171,497 is considered as paid on the remainder; no mortgages or charges.

Potteries Electric Traction Company, Limited (57,968).—This company's annual return was filed on May 16th, when the entire capital of £400,000 in 20,000 ordinary and 20,000 preference shares of £10 each had been taken up. £10 per share has been called up on the preference and 13,334 ordinary shares, resulting in the receipt of £333,340. 6,666 ordinary shares are considered as fully paid. Mortgages and charges, £200,000. Particulars of registered mortgages and charges:—Date of trust deed, July 26th, 1900. The total amount secured by series of debentures is limited to a sum equal to one-half the subscribed

the radius of the fly-wheel, seeing that the linear velocity of

capital for the time being. Dates of resolutions creating series of debentures, March 28th, 1900, and April 30th, 1901. Date of present issue, April 30th, 1901. Amount of present issue, £75,000. Property charged: The undertaking and property, present and future, of the company. Trustees: The Electric and General Investment Company, Limited, 1, Great Winchester Street, E.C. Date of registration, May 8th, 1901. Total amount previously issued in same series, £125,000.

Dudley, Stourbridge and District Electric Traction Company, Limited (14,763).—This company's annual return was filed on May 3rd, when the entire capital of £200,000 in 20,000 preference and 20,000 ordinary shares of £5 each had been taken up and paid for in full. No mortgages or charges.

City of London Electric Lighting Company, Limited (34,406).—This company's annual return was filed on April 30th, when 40,000 preference and 70,595 ordinary shares were taken up out of a nominal capital of £1,200,000 in 40,000 preference and 80,000 ordinary shares of £10 each. £10 has been called up on each share, resulting in the receipt of £1,105,950. Mortgages and charges, £600,000.

Dover Electricity Supply Company, Limited (39,779).—This company's annual return was filed on May 18th, when 10,000 ordinary and 343 preference shares were taken up out of a nominal capital of £75,000 in 10,000 ordinary and 5,000 preference shares of £5 each. £5 per share has been called up, resulting in the receipt of £51,715. Mortgages and charges, £25,000.

Alliance Electrical Company, Limited (57,770).—This company's annual return was filed on May 17th, when the entire capital of £120,000 in 70,000 preference and 50,000 ordinary shares of £1 each had been taken up. £1 has been called up on each preference share, resulting in the receipt of £70,000. £50,000 is considered as paid on the ordinary shares. No mortgages or charges.

Oxford Electric Company, Limited (34,685).—This company's annual return was filed on March 28th, when 10,000 shares were taken up out of a nominal capital of £100,000 in 20,000 shares of £5 each; £5 per share has been called up on 3,510 shares, resulting in the receipt of £17,550; £34,000 is considered as paid on 6,800 shares, including £1,550 considered as paid on 310 forfeited shares. Mortgages and charges, £49,450.

Buenos Ayres and Belgrano Electric Tramways Company, Limited (55,957).—This company's annual return was filed on May 9th, when 100,000 ordinary, 40,300 "A" preference and 27,500 "B" preference shares were taken up out of a nominal capital of £850,000 in 100,000 ordinary, 40,000 "A" preference, and 30,000 "B" preference shares of £5 each. £5 has been called up on each of the "A" preference shares, resulting in the receipt of £200,000. £637,500 is considered as paid on the ordinary and "B" preference shares. Mortgages and charges, £440,000.

SUPPLY STATION ACCOUNTS.

Hull Corporation Electricity Accounts.
Private lighting only.

The accounts of the Kingston-upon-Hull electricity supply undertaking for last year show that the very favourable results attained in past years have been improved upon. The figures given below cover the first two years during which both the generating stations have been at work. The more recent of these, the Sculcoates Lane station, was opened in October, 1898, so that it assisted in the heavy load of the winter of that year, without having to carry the heavy standing charges for the summer season, when its additional plant would not have been fully employed.

General Statement.

	1899.	1900.	Inc.
Total capital expenditure ...	£133,802	**£169,980**	£36,178
Number of units sold	940,192	**1,307,075**	366,883
Maximum kw. demanded ...	1,405	—	—
Gross revenue	£19,291	**£24,577**	£5,286
Gross expenditure	£10,631	**£13,736**	£3,105
Gross profit	£8,660	**£10,841**	£2,181
Average price per unit sold ...	4·69d.	**4·35d.**	−·34d.

The revenue statement shows that the receipts under each head have fallen per unit. The average selling price of energy in 1898 was, roughly, 5d. per unit, in each succeeding year it fell about ¼d. per unit.

Revenue Statement.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£18,390	4·69d.	**£23,714**	4·35d.	−·34d.
Meter rents	617	·16d.	**769**	·14d.	−·02d.
Sales	—	—	—	—	—
Sundry premiums and deposits.	284	·07d.	**94**	·02d.	−·05d.
Gross revenue ...	£19,291	4·92d.	**£24,577**	4·51d.	−·41d.

Coal, which was ·67d. in 1898, rose to ·87d. in 1899 and to 1·12d. in 1900. Notwithstanding this serious burden upon the costs, economies in the other items have allowed the works costs to be brought down under 2d. and the total costs to just over 2¼d., standing at ·04d. less than in 1898.

Cost of Production.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal	£3,398	·87d.	£6,080	**1·12d.**	+·25d.
Oil, waste, water and engine room stores.	416	·10d.	546	**·10d.**	·00d.
Salaries and wages incurred in generation and distribution.	2,455	·63d.	3,098	**·57d.**	−·06d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	1,642	·41d.	1,074	**·19d.**	−·22d.
Works costs	£7,893	2·01d.	£10,798	**1·98d.**	−·03d.
Rent, rates and taxes ..	1,115	·28d.	1,220	**·22d.**	−·06d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	1,155	·30d.	1,294	**·24d.**	−·06d.
General establishment charges, stationery and printing, law charges and insurance.	468	·12d.	424	**·08d.**	−·04d.
Other expenses	—	—	—	—	—
Total cost ...	£10,631	2·71d.	£13,736	**2·52d.**	−·19d.

In the 1899 analysis a sum of £812 is included with sinking fund. This was placed to the depreciation of capital account under the head of "Meters." Financial charges have increased by £2,763, and gross profits by £2,181. The difference causes the net profits to be reduced by £582. Allowing for the amount just mentioned, the net profits in 1899 were £2,736, and last year £2,154. Of the latter sum £923 was written off the capital account "Meters," and £1,231 was taken to the reserve fund, which now stands at a total of £11,324.

Profit Statement.

	1899.	1900.
Interest on loans	£3,230	£4,830
Sinking fund for repayments	3,506	3,857
Net profit carried to depreciation of meters (capital account)	—	923
Net profit carried to reserve fund	1,924	1,231
Gross profit	£8,660	£10,841

Wolverhampton Corporation Electricity Accounts.

The Wolverhampton Corporation accounts for last year show entirely satisfactory results if they are analysed, but to understand the present position it has to be stated that the system has undergone a change. The troubles which in 1898 were attributed to the high tension continuous current system led to the Town Council sanctioning a change-over to the simple three-wire method of supply, with the hope that this conversion would enormously reduce the possibility of further breakdown. The change was in progress during the latter half-year of 1899, and was practically completed in 1900, the second of the two years dealt with below. This change meant an extraordinary inflation of the costs, and if this special expenditure be allowed for the accounts show that all charges were met.

General Statement.

	1899.	1900.	Inc.
Total capital expenditure ...	£74,066	**£92,284**	£18,218
Number of units sold	482,277	**633,538**	151,261
Maximum load in 32-watt lamps	25,184	**33,833**	8,649
Gross revenue	£9,476	**£11,457**	£1,981
Gross expenditure...	£6,094	**£6,772**	£678
Gross profit	£3,382	**£4,685**	£1,303
Average price per unit sold ...	4·61d.	**4·25d.**	−·36d.

The maximum load has increased by over 30 per cent., and the units sold by rather less than 20 per cent. This has hardly realised the expectation that the increasing use of motive power would

improve the load factor. Private consumers of the better class may be desirable customers in many ways, but do not as a rule show very well in this particular respect. The average receipts for energy sold are down to 4¼d. per unit, at which figure the department should command public support, especially as the rates of 6d. and 3d. on the demand scale are moderate.

REVENUE STATEMENT.

	1899. Gross	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£9,260	4·61d.	£11,220	4·25d.	—·36d.
Meter rents	178	·09d.	225	·08d.	—·01d.
Supply of fittings and work done for consumers	38	·02d.	12	·01d.	—·01d.
Sundry fees, &c.	—	—	—	—	—
Gross revenue ...	£9,476	4·72d.	£11,457	4·34d.	—·38d.

The only item in the costs which shows a plus sign is that entirely outside the engineer's control, viz., rent, rates, &c., and even here the change is inappreciable. The larger items of wages and salaries have come down, while coal is unaffected. Works costs stand exactly at 2d. and total cost at just over 2½d. per unit. including the special item of repairs, or 1·79d. and 2·35d. respectively deducting this, figures which compare well with the 1·81d. and 2·65d. of 1898, when there were no such charges.

COST OF PRODUCTION.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal..	1,888	·94d.	£2,480	·94d.	—·00d.
Oil, waste, water and engine room stores	364	·18d.	379	·14d.	—·04d.
Salaries and wages incurred in generation and distribution, and attendance, repairs, &c., of public lamps	1,394	·69d.	1,613	·61d.	—·08d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	327	·16d.	268	·10d.	—·06d.
	912*	·46d.*	546*	·21d.*	—·25d.*
Works cost ...	£4,885	2·43d.	£5,286	2·00d.	—·43d.
Rent, rates and taxes ..	183	·09d.	270	·10d.	+·01d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	712	·35d.	826	·31d.	—·04d.
General establishment charges, stationery and printing, law charges and insurance	314	·16d.	390	·15d.	—·01d.
Other expenses	—	—	—	—	—
Total costs ...	£6,094	3·03d.	£6,772	2·56d.	—·47d.

* "Changing over system of distribution of electricity."

The profit of 1899 was added to the sum of £416 in hand from previous years, and taken to form a reserve fund. Last year the financial charges increased over 1899 by £1,837, and the gross profit by only £1,303. The difference of £534 swallowed up the profit of £403 in 1899, and left a net loss of £131, but it may be noted that this difference is almost exactly equal to the special expenses for change of system, and if these be excluded the profit balance is the same as in the previous year. In other words, had the reserve fund met these expenses the working would have shown similar results to those of 1899.

PROFIT STATEMENT.

	1899.	1900.
Interest on loans	£1,655	£2,646
Sinking fund for repayments	1,324	2,170
Net profit carried to reserve fund	403	—
" " forward	—	—131
Gross profit	£3,382	£4,685

CITY NOTES.

Electrical Power Storage Company.

THE directors' report to May 31st states that the profit for the year is £5,665 9s. 5d. Adding the balance brought forward, made £5,923 17s. 1d., of which £1,000 has been carried to contingent fund. A dividend of 5 per cent. on the ordinary share capital absorbs a further £4,491 8s., leaving £432 9s. 1d. to be carried forward. The buildings, plant, tools, &c., have been well maintained at a cost of £2,698 12s. 11d., provided out of revenue. A Gold Medal was awarded to the company at the Paris Exhibition. Advantage has been taken of an opportunity for increasing the area of the works at Millwall, and this has enabled substantial fireproof stores to be erected. The amount of work turned out has been in excess of that of any previous year, although the increased cost of raw materials has obliged the company to charge higher prices for its manufactures. Numerous important contracts for power and lighting stations have been completed, and a number of similar contracts for Corporations and lighting companies are in course of execution. The staff has given much attention to the improvement of the traction type of cell for use in electrically-propelled vehicles, and the company is doing a considerable and increasing business in this class of work.

United River Plate Telephone Company.

MR. J. I. COURTENAY presided at the annual meeting held on Tuesday at Winchester House. In moving the adoption of the report, he said that it might be considered the most satisfactory statement they had ever laid before the shareholders. The business was expanding in all directions, and while trade generally in the River Plate for the last 12 months had been poor, the interests of the company have suffered but little thereby. After referring to the capital account, he said that the balance of profit was within £250, the same as last year. There had been an additional capital outlay of £30,968, represented, in the main, by underground plant. Sundry debtors were considerably increased, chiefly on account of advances to manufacturers for materials, a large part of which had now been shipped. Real estate in the River Plate, £85,087, represented their five principal central office properties in Buenos Ayres and La Plata, which were worth much more than the amount at which they stood, constituted permanent centres, not subject to exorbitant increase of rents or inconvenient eviction. Securities at cost, £120,682, was another tower of strength. Their actual value at Stock Exchange prices was about what was paid for them. That this large sum would be rapidly reduced by the expenditure on the underground plant. Profit and loss account on the debtor side showed an increase of £6,330 in expenses in the River Plate, the greater part of which was attributable to a general and necessary increase of wages in Buenos Ayres, and to the numerous changes of lines and routes rendered necessary by the improvements and rebuilding now in progress in that city. The receipts from subscriptions and other sources had increased £8,370, and from dividends and interest £1,673, a total of over £10,000 increase. The result was that they wrote off the whole of the expenses connected with their late issue of preference shares, placed £15,000 to reserve, and after providing for the final dividend on the ordinary shares, making 7 per cent. for the year, carried forward £6,058. The board considered it most desirable that the reserve fund, already a strong feature (which now amounts to £55,000), should be substantially increased, and they had confidence that the earnings of the business would regularly permit this to be done.

Mr. JONES, the managing director, who had spent a good deal of time recently in the River Plate, then gave a brief statement regarding the company's operations, and, in conclusion, seconded the adoption of the report.

This was carried unanimously after a few observations from shareholders, as were also other resolutions re-electing directors and re-appointing auditors. Special resolutions bringing the articles into line with the new Company Act were subsequently passed, and a vote of thanks to the chairman closed the meeting.

The Electric Construction Company.

THE directors' report to be submitted to the annual meeting to be held on Thursday, July 11th, at Winchester House, at 12 noon, reads as follows:—

The profit of the year ending May 31st last, including the balance of £4,777 1s. 9d. brought forward, is		£30,018 18 2
which your directors recommend to be appropriated as follows:—		
In providing dividends of 7 per cent. on the preference shares (to be paid on July 31st next)..	£3,713 0 0	
and of 6 per cent. on the ordinary shares (one-half to be paid on July 31st next, and one-half on January 31st, 1902) ..	18,453 0 0	
And in adding to the general reserve fund the premium on the preference shares	4,792 10 0	
and from surplus profits	5,207 10 0	
		27,165 0 0
Leaving a balance of ..		£2,853 18 2

to be carried to next year's accounts. The general reserve fund will then amount to £30,000. The buildings and plant have been thoroughly maintained, and £5,000, as usual, has been credited to depreciation account, which now amounts to £38,000. The new factory is now equipped with the best labour-saving tools and appliances, capable of turning out economically and with despatch the largest electrical machinery that may be required, but the full benefit of the expenditure has accrued only during the latter part of the year. The electrical equipment of the extension of the City and South London Railway, completed last year, has given full satisfaction both to the railway company and to the public, and another contract for a further extension has been entered into with the railway company. The works are well supplied with orders, and a great demand for electrical plant is anticipated in the near future. The relations with all classes of the employés continue satisfactory, and the directors have much pleasure in awarding the usual bonus in recognition of good service. The compensation paid under the Workmen's Compensation, 1897, Act, is for the year £295 15s. 7d. The Madras Electric Tramways have yielded a moderate return on their cost to the company, and the traffic is steadily increasing. It is considered expedient to amend the articles of association to bring them into harmony with the Companies' Act (1900), and notice of the special resolution necessary appears on the back of this report. The directors who retire by rotation at the general meeting (and who are eligible for re-election) are Messrs. Barclay and Courtenay. The directors recommend that Mr. James Gray, who has been for eight years secretary, be elected to a seat on the board. The auditors, Messrs. James Meston & Co., offer themselves for re-election.

The British Continental Electricity Company.

THIS company holds its annual meeting at Westminster, on Friday, July 12th, and the following report has been issued:—

During the year 1900—1901 80 applications have been received for electric light The number of 8-C.P. lamps added during this period has been 2,462, while the gross receipts from sale of current show an increase of 20 per cent. over those

per unit.

of last year. After setting aside £79 6s. 8d. as depreciation in respect of furniture, tools, meters, &c., and £37 9s. 10d. for discounts and bad debts, writing off £75 from preliminary expenses, and £30 from special legal expenses, the balance standing to the credit of revenue account is £774 13s. 6d., which, taking into account the fact that the Riviera season has been an unfavourable one, and that the average price of coal has been even higher than that of last year, the directors consider satisfactory. Of the above balance £270 15s 11d. has been absorbed in the payment of the interim dividend at the rate of 5½ per cent. per annum on the cumulative preference shares, leaving a balance of £503 17s. 7d., which the directors recommend shall be appropriated as follows:

1. By payment of a dividend at the rate of 5½ per cent. per annum on the cumulative preference shares for the past half-year	£275	0	0
2. By payment of a dividend at the rate of 2 per cent. per annum for the year on the ordinary shares	166	12	6
3. Leaving a balance to be carried forward	61	5	1
	£503	17	7

In comparing the above balance with that of the previous years, the directors wish to point out that, having at length been able to ascertain approximately the amount payable in respect of foreign income-tax (to cover which a balance of £139 13s. was carried forward last year), they have reserved out of this year's profits a large sum to meet all claims in respect of this tax for the past three years. The amount appearing in the balance-sheet under the heading of special legal expenses has been incurred in actions by which the company will benefit in the future, and the directors consider, therefore, that the whole of this sum should not be charged against this year's income. The sum of £2,589 16s. 11d. has been spent on capital account during the year, including the purchase of an 80-kw. steam alternator. The reserve fund has been strengthened by the addition of the sum of £71 8s. 4d.

An extraordinary meeting will be held after the general meeting for making an alteration in one of the articles.

Thomas Parker, Limited.

The seventh annual meeting will be held at the Works, Wednesfield Road, Wolverhampton, on Monday, July 8th. The directors' report reads as follows:—

Your directors have pleasure in submitting the annexed balance-sheet, which they consider very satisfactory, especially in view of the high prices of coal and raw materials. After writing off the various depreciations the balance standing to the credit of profit and loss account is £11,021 17s. 6d.; out of this the directors propose to pay a dividend at the rate of 10 per cent. per annum, less income-tax, to place £2,500 to the reserve fund, bringing it to £17,500, and to carry the balance forward to next year's account. The director who retires by rotation is Mr. W. Thomas, who is eligible, and offers himself for re-election. The auditors, Messrs. Allen Edwards & Smith, also retire, are eligible, and offer themselves for re-election.

A special meeting follows the general meeting to effect alterations in the articles.

Prospectuses.—The New General Traction Company has this week been inviting subscriptions for an issue of £200,000 5 per cent. debentures at par, for the purpose of paying off certain indebtedness and to provide funds for new business.

An issue of 10,000 £5 6 per cent. preference shares, and of £75,000 5 per cent. debenture stock at par, in the Electric Lighting and Traction Company of Australia has been before the public this week. The list closed yesterday.

Electric and General Investment Company.—The report for the year ended May 31st shows a gross profit of £18,574, and a net balance of £10,400. The directors propose to pay a dividend of 5s. per share for the year ended May 31st, 1901, and a bonus of 2s. per share. The founders' shares receive a dividend of £50 per share. Warrants for the dividend, payable July 1st, on the 6 per cent. cumulative preference shares have been posted.

Electric Construction Company, Limited. — The directors recommend a dividend on the ordinary shares, for the year ended May 31st, at the rate of 6 per cent. per annum, one-half payable on July 31st, 1901, and the other half on January 31st, 1902, and that £10,000 of the surplus profits be carried to general reserve account.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be quoted in the Official List:—Eastern Telegraph Company, Limited. Further issue of £103,919 3½ per cent. preference stock.

South Lancashire Electric Traction and Power Company.—Warrants for the interest to June 30th on the 4½ per cent. first mortgage debenture stock were posted on Saturday.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending June 28th were £473; corresponding week last year, £459; increase, £14. Total to date, £12,056, corresponding period last year, £11,000: increase, £1,056. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for eight days ending June 30th were £920; corresponding week last year, £724: increase, £196. Total to date, £9,937; corresponding period last year, £10,126; decrease, £189.

Bristol Tramways and Carriage Company.—The receipts for the week ending June 28th were £4,743; corresponding period last year, £3,148; increase, £1,595.

Central London Railway.—The receipts for the week ending June 29th were £6,144; previous week, £6,262; decrease, £118. Total receipts to date (26 weeks), £161,176. Miles open, 6.

City and South London Railway.—The receipts for the week ending June 30th were £1,868; corresponding week last year, £1,490; increase, £378. Total to date, £50,839; corresponding period last year, £33,725; increase, £17,114. Miles open, 4¾.

Dover Corporation Tramways.—The receipts for the week ending June 29th were £239 9s. 4d.; corresponding week last year, £213 0s. 3d.; increase, £16 9s. 1d. Total to date, £1,853 15s. 0½d.; corresponding period last year, £1,501 9s. 9½d.; increase, £351 5s. 3d. Miles of track open, 3. Car miles run, 1901, 5,113; 1900, 4,987. Number of cars, 11.

Dublin United Tramways Company.—The receipts for the week ending June 28th were as follows:—D.U.T. Co., electric cars, £3,965 4s. 7d.; D.S.D. Co., electric cars, £913 10s. 4d.; total, £4,908 14s. 11d.; corresponding week last year—D.U.T. Co., electric cars, £3,602 4s. 6l.; ditto, horse cars, £59 4s. 8d.; D.S.D. Co., electric cars, £963 9s. 5d.; total, £4,624 18s. 7d.; increase, £283 16s. 4d.; aggregate to date, £107,588 5s. 9d.; aggregate to date last year, £107,965 11s. 0d.; decrease, £377 5s. 3d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and two miles by horses, for the corresponding period last year.

The receipts for the two days ending Sunday, June 30th were as follows:—D.U.T. Co., electric cars, £1,534 8s. 3d.; D.S.D. Co., electric cars, £477 14s. 7d.; total, £2,012 2s. 9d.; corresponding two days last year, D.U.T. Co., electric cars, £1,356 19s. 6d.; ditto, horse cars, £21 0s. 7d.; D.S.D. Co., electric cars, £381 4s. 4d.; total, £1,659 4s. 5d.; increase, £352 18s. 4d.; aggregate to date, £109,597 6s. 10d.; aggregate to date last year, £109,373 6s. 2d.; increase to date, £224 0s. 8d.

Liverpool Corporation Tramways.—Traffic returns for the fortnight which ended on June 22nd were submitted, and showed that the receipts had been £18,291 2s. 0d., an increase of £1,916 12s. 2d. over the corresponding period last year. The mileage run was 426,868, an increase of 77,997. The number of passengers carried was 3,959,620, an increase of 767,209. 313 cars were at work, of which six only were horse vehicles.

Liverpool Overhead Railway.—The receipts for the week ending June 30th were £1,696; corresponding week last year, £1,682; increase, £14. Total to date, £40,981; corresponding period last year, £37,502; increase, £3,479. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The period which has elapsed since the end of June account was arranged, is recognised on all hands to have been the dullest portion of an admittedly dull season. The fact that the new account is a "long" one has been taken advantage of alike by the dealers and the public to secure some portion of their summer holidays, and an escape from the oppressive heat of the "House" and Throgmorton Street; consequently business all over the Stock Exchange has been reduced to the smallest dimensions, and even in those markets which a few weeks ago were comparatively active, bargains are of rare occurrence, and the attendance of members far below the normal standard. The market for electric shares has not, of course, escaped the general depression, and there are comparatively few changes to record as the result of the week's dealing. Speculation in this department is for the moment entirely dormant, and where alterations are made in quotations they are due on the one hand to a little realisation, or in the other direction to a certain amount of small investment purchases which has taken place during the week, owing probably to the release of half-yearly dividends. Amongst electric lighting shares changes to note are rises of ¼ in Calcutta Electric, and a similar amount in Edmundsons, while Cape Town and District improved ½ to 15½. In the other direction Alliance and Dublin at 19, City of London Electric at 8½, Metropolitan Electric at 13½, and St. James's and Pall Mall at 15, each show a relapse of ½ from the quotations of last week, and Folkestone supply are ¼ easier at 5¼, the remainder of our list being unchanged. The section for telegraph and telephones has been more than usually neglected, dealings being only on the most limited scale; changes consequently are far from numerous, practically resolving themselves into a slight fall in Commercial Cable Debentures, and a rise of ¼ in National Telephone and Chili Telephones respectively.

In the tramway and traction section Anglo-Argentines have been a pretty good market, and have changed hands up to about 4½, remaining firm at a fraction under that figure. British Electrics have been in some demand, and close firm at 15¼, having changed hands at higher prices during the week. There has been some investment buying of Buenos Ayres and Belgrano, second Debentures and stock proving in short supply, the price has somewhat improved. Dublin Trams are dull at 12¼. Provincials ½ easier at 6, and Brisbane Preference ¼ lower at 4¼. The Electric Railway market has scarcely received any attention during the week, and values remain practically unchanged, although City and South London are nominally marked down a point, and ditto. Debentures up a similar amount. Taking the market as a whole, it may fairly be said that the electric department has held its own as well as, if not better than, any other section of the Stock Exchange, and containing as it does so many examples of commercial success and proved good dividend-earning capacity, it seems hardly possible that it can be neglected by the public much longer, and the probability of this being one of the first markets to feel effects of that better condition of business, which is now being confidently expected, is far from remote. This view is to some extent borne out by the reception accorded to the report of the Electric Construction Company, which was considered favourable by the market, and the price improved upon some small purchases.

The staff has given much attention to the improvement of the

The number of 8-C.P. lamps added during this period has been 2,362, while the gross receipts from sale of current show an increase of 20 per cent. over those

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation June 26th.	Closing Quotations July 3rd.	Business done during week ended July 3rd. 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs	100	...	...	...	100 —103	98 —101 xd	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,200 Red. ...	100	...	...	...	78 — 83	78 — 83	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	53 — 56	53 — 56	53	...
3,088,540£	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	98 —100	98 —100	99½	98¾
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	10 — 10½	10 — 10½	10 1/16	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	...	3¾— 4¼	3¾— 4¼	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185 xd	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	100 —102 xd	101¼	100⅞
16,000	Cuba Telegraph	10	8 %	7 %	...	7 — 8	7 — 8	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	14½ — 15½	14½ — 15½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	100 —104%	99 —103%xd	...	...
60,710£	Direct United States Cable	20	3½%	3 %	3 %	10½— 11	10½— 11½	11 1/16	10 15/16
104,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	99 —102 xd	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	140 —145	140 —145	144½	142
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	90 — 93	89 — 92	91½	89
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	109 —113	109 —113	...	...
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13½— 14	13½— 14	13⅞	13⅝
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	111 —116	111 —116	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	...	9⅜— 10¼	9⅜— 10¼	10	9⅞
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14⅜— 15¼	14⅜— 15¼	15⅛	14 13/16
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	30 — 32	30 — 32	...	...
78,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 -103	99 —102 xd	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	43 — 47	43 — 47	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼— ⅜	¼— ⅜	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	¾— 1	¾— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3 — 3½	3½— 3⅝	3⅛	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 12	11 — 12	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 12	11 — 12	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4 — 4½	4⅜— 4⅝	4¼	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	89 — 92	87 — 90 xd	90	87
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	96 — 99	94 — 97 xd	97	96⅛
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	100 —103	99 —102 xd	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	127½	...
58,000	United River Plate Telephone	5	6 %	7 %	...	5 — 5⅛	5 — 5⅛	5⅜	5⅛
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅞— 5⅛	4⅞— 5⅛xd	5⅜	4⅞
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	101 —104 xd	101	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	100 —103	99 —102 xd	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13⅜— 14¼	13⅜— 14¼xd	14	...
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	101 —104 xd	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	100 —103 xd	...	...
88,321	West India and Panama Telegraph	10	2 %	5%	...	⅜— ⅝	⅜— ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5 — 6	5⅛	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	103 —106	101 —104 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅜— 8¼	7⅜— 8¼	...	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8½— 9	8½— 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	9⅜	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5⅜— 6¼	5⅜— 6¼xd	5 13/16	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	107 —110 xd	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8½— 9½	8 — 9	8½	8⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	120 —125 xd	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8½— 9½	8½— 9½	9⅛	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	105 —108	103 —106 xd	105¼	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	...	5½— 5⅝	5½— 6	5 1/16	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 5⅝	5½— 5⅝	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	104 —107	104 —107	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11½— 12½	11½— 12½	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	102 —105	102 — 105	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13½— 14½	13 — 14	13⅜	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	110 —113	108 —111 xd	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	94 — 97 xd	...	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½— 16½	15 — 16 xd	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	14½— 15½	14⅜	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	97 —100 xd	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	12 — 13	12 — 13	...	...

* Subject to Founders Shares. Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital.
—Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

£17,114. Miles open, 4¾.

upon some small purchases.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years.			Closing Quotation June 26th.	Closing Quotation July 3rd.	Business done week ended July 3rd, 1901.	
		‡	1898.	1899.	1900.			Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7½ — 8½	7 — 8	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93	89 — 93	...	...
45,000	British Electric Traction	10	6 %	8 %	9 %	14½ — 15½	15 — 16	15½	15
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12⅜	12 7/16
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	122 —125	122 —125	125	123¾
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	9½ — 10½	10 — 11	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	2	5 %	6 %	...	1⅝ — 1⅞	1⅝ — 1⅞	1⅝	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2⅛ — 2⅜	2⅛ — 2⅜	2 1/16	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	101 —104	99 —102 xd	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	14 —15	14 — 15	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	9¼ — 9⅜	9¼ — 9⅜	...	...
78,703	Do. do. Pref. half-shares	5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	5	...
78,703	Do. do. Def. do.	5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	...	...
855,000	City and South London Railway	Stock	2½%	1⅝%	1½%	55 — 57	54 — 56	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5½ — 5⅝	5½ — 5⅝	5⅝	5 7/16
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	...	3½ — 4	3½ — 4	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	102 —107	100 —105 xd	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	1 — 1½	1 — 1½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	...	2 — 3	2 — 3	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	87 — 89	80 — 85 xd	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	94 — 98	94 — 98	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6%	1⅝ — 2¼	1⅝ — 2¼	1 1/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2½ — 3	2½ — 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	100 —103	100 —103	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	15½ — 16½	15½ — 16½	...	...
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	107 —111	107 —111	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21⅝	21¼
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3⅝%	3½%	8⅛ — 8½	8⅛ — 8½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13½	13 — 13¼	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	36 — 40	36 — 40	37¼	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	101 —104 xd	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10 — 11	10 — 11	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	5⅝	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	93 — 96	92 — 95	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/16—⅛
National Electric Free Wiring, 12/6 paid, 11/16—11/16.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16½.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (June 6th, 1901).

MARKET QUOTATIONS, Wednesday, July 3rd.

CHEMICALS, &c.		Last week.	This week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	30/-	30/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£15	£15	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£23	£23	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8½d.	8½d.	..
a ,, Caustic (75/90%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	61/-	61/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£8	£8	..
,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £140	£75 to £140	..
Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
Tube (brazed)	per lb.	10d.	10d.	..
e ,, ,, (solid drawn) ..	per lb.	8½d.	8½d.	..
e ,, Wire, basis	per lb.	8d.	8d.	..
e Copper Tubes (brazed) ..	per lb.	11d.	11d.	..
e ,, ,, (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£85	£85	..

METALS, &c, *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£85	..
g ,, Rod	per ton	£85	£85	..
c ,, (Electrolytic) Bars ..	per ton	£82	£82	..
c ,, ,, Sheets ..	per ton	£90	£90	..
c ,, ,, Rod ..	per ton	£84	£84	..
c ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f ,, Sheet	per lb.	5/-	5/-	..
h German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/8 to 3/9	3/9	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	45/	44/2	10d. inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£10 5	£10 5	..
g Lead, English Ingot	per ton	£12 12 6 to £12 15	£12 12 6 to £12 15	..
g ,, ,, Sheet	per ton	£13 10	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40		..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£132 to £133	£131 10 to £132	inc.
g ,, foil	per lb.	1/6	1/6	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals —				
"White Ant" brand	per ton	£35 to £65	£35to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	8¼d.	8¼d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4¾d.	4¾d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5¾d.	5¾d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 5	£14 5	..
k Zinc, Sh'ts. (Vielle Montagne bnd.)	per ton	£22 10	£22 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. e Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Bolling & Lowe. j Messrs. Henry C. Yoe & Co.

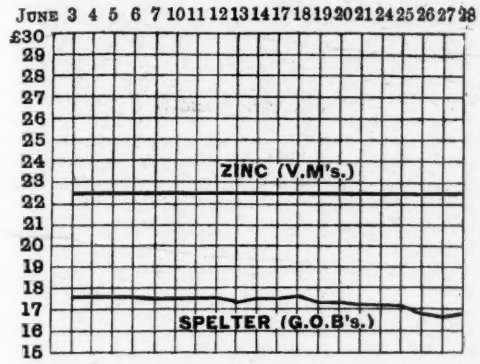
Quotations supplied by { k Messrs. Morris Ashby, Limited m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company Ltd.

79,900	Westminster Electric Supply, Ord., 10l to 80,000...	...	5	12 %	13 %	10½ %	12 — 13	12 — 13	...	...

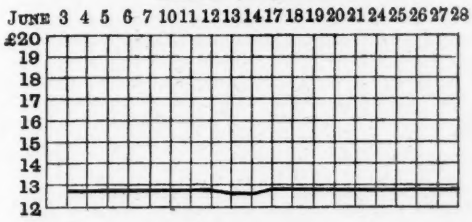
* Subject to Founders Shares. Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
=Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

METAL MARKET.

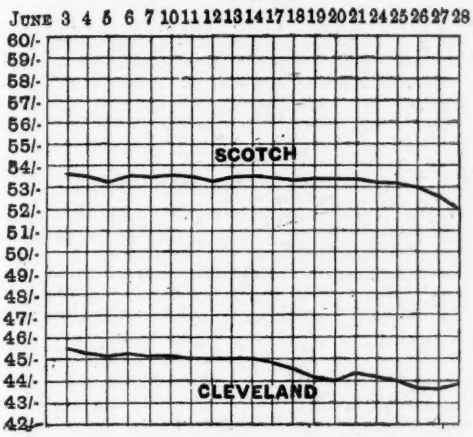
Fluctuations in June.



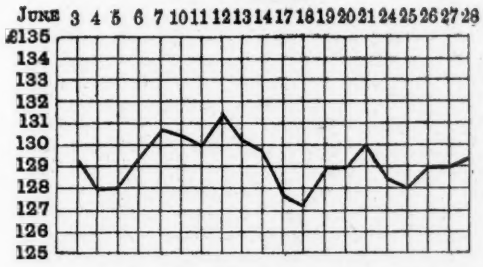
LEAD (ENGLISH).



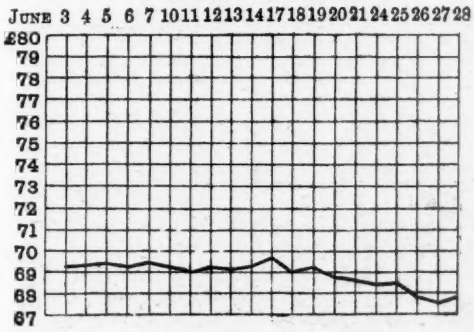
IRON.



TIN.



COPPER (G.M.B's.)



CURRENT SPECIFICATIONS.

LXIX.—CLECKHEATON EXTENSIONS.

Summary.

Extent of Contracts.—Supply and erection upon prepared foundations ready for setting to work two motor balancers and boosters, and also supply and erection of one main switchboard.

Type of Motor Balancers and Boosters.—To consist of four machines directly coupled together and mounted on one bedplate. Balancers to be placed in centre of combination. Eight bearings are to be provided, and provision made for running any machine separately if desired.

Output of Machines.—Each balancer to be capable of an output of 11·5 kw. at 230 volts, and each booster of 40 amperes at any voltage between 10 and 70 volts.

Specified Speed of Combination.—Not to exceed 1,000 revolutions per minute.

Permissible Temperature Rise.—Not to exceed 70° F. above surrounding atmosphere when measured thermometrically after a full load run of 12 hours' duration.

General Design of Switchboard.—To contain 12 panels in all, and to be suitable for a combined lighting and traction continuous current system.

Number of Regulating Contacts on Battery Switches.—Forty on each switch.

System of Charging Cells.—Methods of charging end cells by means of boosters to be proposed by tenderers and to be approved by engineers.

Specified Date of Completion.—October 30th, 1901, for either section.

Penalty for Late Completion.—For motor balancer section, £5 per week: for switchboard, £10 per week.

Specified Terms of Payment.—For motor balancer section, 80 per cent. on engineers' certificate of satisfactory completion and 20 per cent. 12 months later; for switchboard section, 90 per cent. on satisfactory completion and 10 per cent. 12 months later.

Period of Maintenance.—Twelve months from date of completion.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be paid to Workmen.—None.

Stipulations as to Sureties.—Two to be arranged for with each section; for the motor balancer to a value of £62; for the switchboard section to a value of £200.

Arbitration Proposals.—See comments below.

Date for Receipt of Tenders.—July 6th, 1901.

These specifications are issued by the firm of Messrs. Gibbings & Baker, the consulting engineers to the Corporation.

There is little to comment upon in the technical requirements. It will be noted that for the motor balancer and booster eight bearings are specified, and means are to be provided for running each machine separately if desired. The temperature rise in any part of the windings is to be measured after a 12 hours' full-load run—not 6 hours, as usual—70° F. being permissible.

The general conditions are in many respects acceptable, though the wording and arrangement is very different from what may be termed the model clauses. This is specially noticeable in the arbitration clause, which only states that any failure to agree as to the value of any extra work may be referred to arbitration, and makes no provision for the submission of *all* disputes to the same tribunal. We object to these limited arbitration proposals, and in the present case consider the omission of the standard clause more noticeable, because one of the members of the firm of consultants, Mr. A. H. Gibbings, was President of the Municipal Electrical Association at the time of the conference of that body with the Electrical Plant Manufacturers' Association, when the model clauses were agreed to, and that gentleman's signature consequently heads the list of those signing as representing the Municipal Electrical Association.

Wallasey.—The first length of rail (98 lbs.) of the projected electric tramways for the Urban District of Wallasey was laid by Mr. W. G. Ellery, chairman of the D.C., on Wednesday of last week. The scheme will comprise about 10 miles of tramway, which will serve the townships of New Brighton, Egremont, Seacombe, Wallasey and Poulton, in the Wirral district of Cheshire. The track will be single, of 4 ft. 8½ in. gauge, with a sufficient number of passing places. The work is under the direction of Mr. W. H. Travers, district engineer. The cars are expected to be fully at work within 12 months.

Quotations supplied by
a Messrs. Thos. Bolton & Sons.
b The British Aluminium Co., Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons.
e Messrs. Frederick Smith & Co.

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g Messrs. James & Shakspeare. [Co., Ltd.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo &Co.

Quotations supplied by
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company Ltd.

INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION (GLASGOW CONVENTION).

THE EQUITABLE ALLOCATION OF COSTS IN COMBINED LIGHTING AND TRACTION STATIONS.

Abstract of paper read by W. H. TITTENSOR, Electrical Engineer Dundee Corporation.

THE question as to whether power for traction should be generated by a combined lighting and power plant or in a station specially erected and fitted up with plant for that purpose alone, is the one problem, perhaps, which at the present moment is most urgently in need of the attention alike of the local authority and the electrical engineer. The two modes of procedure generally adopted in such a case are neither of them quite without more or less serious objections. (1) The outside expert, carefully formed as his opinion may be, is liable to be biassed by the "personal element," and this may be responsible to a great extent for the expert's decision in favour of a separate station. (2) In the case of the resident engineer responsible for the running of the lighting station, the personal element, together with a better load factor, larger plant and correspondingly increased allocations to management expenses, may influence his decision in favour of a combined station.

If a local authority were asking for a supply either of electrical energy or of any other commodity from two or more outside companies, it would, without hesitation, decide to buy from the cheaper source. The questions that the undertakers have to decide, therefore, are (1) Can the combined station *generate* as cheaply as the separate station? and (2) which of these two stations can *supply* at the cheaper rate? The first question is one that any qualified adviser *with a knowledge of local conditions* can advise upon and be able to produce facts and figures to support his conclusions. The second question is one that many people would naturally expect to be dependent upon the first, but such is by no means the case, since that unknown element, "policy," has to be reckoned with.

The author has always held that supplies of a *purely public nature* should be given at *cost price*. Under this head would be included, for example—(1) Public street lighting, (2) sewage pumping, (3) tramways, &c. On the other hand, however, no public works or department should be run on the lines of a "philanthropic institution."

The particular question dealt with in this paper is the cost of generation in a combined station. When the existing station is provided with *suitable plant*, and the "centres of gravity" of the lighting and traction systems coincide, the cost of generation should be cheaper in a combined station than in a separate station, *if the costs are equitably allocated*. These should be in proportion to the plant used for tramway purposes, and not according to the total output of the station for both lighting and traction, or, in other words, the costs should be allocated on the basis of the maximum demand upon the plant only used for supplying the tramways, and not on the whole of the generating plant in the station. The traction plant should be treated as an individual consumer, and supplied at a rate proportionate to the cost of generating the power required. Treated in this manner, the tramways are in a unique position, inasmuch as their maximum demand can be pretty accurately foretold and provided for. On the other hand, the cost of supplying a lighting system spread over some hundreds of consumers with a variable maximum demand must necessarily be greater than the cost of supply to a traction system.

The method adopted for determining the *selling price* of current to consumers supplied on the maximum demand system is pretty generally understood.

The method of arriving at the *cost of generation* may, however, be dealt with on simpler lines, owing to the fact that in most stations the plant capacity is, or should be, well in excess of the actual maximum demand at any one time, in order to provide against interruption to the supply arising from breakdowns. The costs of "generating" and "supplying" electrical energy constitute two separate and distinct problems, and as such must be treated in accordance with attendant circumstances.

In a given station the total standing charges will be the same, whatever the number of consumers connected may be, or their total maximum kilowatt demand on the plant, but the cost of generation will vary in inverse ratio to the *number of units generated*, and it is unnecessary to take into consideration the maximum kilowatt demand in determining the cost per unit generated.

It is, however, necessary in "supplying" individual consumers to differentiate in accordance with their maximum kilowatt demands, in order to arrive at the cost per unit delivered at their terminals.

In considering the present subject, the author deals only with the *cost of generation per unit*.

It is generally understood that the total cost is divided into standing charges and running charges, and in order to arrive at the relative costs of generating electrical energy for lighting and tramway purposes respectively, it is necessary to remember that the standing charges allocated to the tramways as a consumer are not affected by the actual maximum demand at any one time on the plant, but are dependent upon the total plant capacity *installed for tramway purposes only*. This is owing to the fact that up to the present it has not been found advisable to run tramways and lighting simultaneously from the same generators.

Taking, as an example, a combined station supplying both lighting and traction, it will be found that certain plant is set aside and used for tramway work only, and it does not matter therefore what the load factor may be, the standing charges on such plant will be constant. In determining the cost of generation, the crux of the matter lies in the allocation of costs. For the purpose of comparison, the following headings will be used:—

Standing Charges.—Interest; sinking fund; management expenses; insurance; rents, rates.

Running Charges.—Wages; fuel; oil, &c.; repairs.

Dealing with these headings singly, the amount allocated to the tramways account under each item should be determined on the following lines:—

STANDING CHARGES.

(*a*) *Interest and Sinking Fund.*—Charged on the full value of the plant and apparatus in use. Charged on one-half of the value of the stand-by plant required and available for lighting purposes also.

(*b*) *Management Expenses.*—Charged in proportion to the value of the plant included in the above and inclusive of clerical expenses actually involved.

(*c*) *Insurance.*—Charged in proportion to the value of the plant (*a*).

(*d*) *Rents, Rates, &c.*—Charged in proportion to the ground space occupied by plant included in (*a*).

(*e*) *Wages.*—Charged in accordance with the actual proportion paid to firemen, drivers and attendants required on each shift during the hours that tramway plant is running.

RUNNING CHARGES.

(*f*) *Fuel.*—Charged on the actual fuel required for the running of the tramway plant.

When steam is taken from a common bank of boilers the cost of fuel per unit must not be obtained by dividing the total weight of fuel used by the total number of units generated; this would be unfair to the traction plant, for assuming that the latter is kept in proper repair, its efficiency will remain practically constant and the fuel consumption will vary but slightly, whereas in the case of the lighting plant the active stand-by losses vary considerably according to the lighting season of the year. By "active stand-by losses" is meant such losses as occur in the winter months when boilers have to be kept banked for several hours per day in readiness for the peak of the loan in the evening. In the author's opinion it would be to the advantage of the traction plant to have its own boilers separate and entirely shut off from those of the lighting, as by this arrangement the proportionate consumption of fuel for traction could be ascertained without any difficulty. Where it is considered desirable, however, to have only one steaming plant for both traction and lighting, periodical tests of the efficiency of the traction plant should be made, when the actual fuel consumption per unit can be ascertained and apportioned accordingly.

(*g*) *Oil, &c.*—Charged on the actual quantity used on the plant in operation.

(*h*) *Repairs.*—Charged in accordance with the actual material used plus the cost of labour (as shown on time sheets) necessary to maintain the plant in good order.

As an illustration, let a combined station be taken as follows:—

Annual output for lighting	835,000	units.
" " traction	500,000	"
Total output	1,335,000	"

Total capacity of plant, 1,300 KW.

Maximum demand for traction purposes, 300 KW.

Total capital spent on plant, buildings, &c., £63,662, or an average of £48·9 per KW.

The actual value of plant installed for tramway purposes was £15·6 per KW. (exclusive of mains and outdoor appliances).

The total cost of generation was £11,125 per annum, made up as follows:—

Standing Charges.	£	s.	d.		
Interest	1,401	15	0	= ·252d.	per unit generated.
Sinking fund ...	967	17	6	= ·174d.	" "
Management account	912	5	0	= ·164d.	" "
Rents, taxes, &c....	1,223	15	0	= ·22d.	" "
Wages	912	5	0	= ·164d.	" "
	5,417	17	6	= ·974d.	" " or £4 3s. 4d. per KW.
Running Charges.					
Fuel, &c.	3,726	17	6	= ·67d.	per unit generated.
Oil, &c.	367	2	6	= ·066d.	" "
Repairs	1,613	2	6	= ·29d.	" "
Total	£11,125	0	0	= 2·000d.	" "

The cost of generating 500,000 units under these conditions for tramway purposes, was

$$\frac{450{,}000}{500{,}000} + 1{\cdot}026 = 0{\cdot}9 + 1{\cdot}026 = 1{\cdot}926\text{d. per unit generated.}$$

Under these apparently most favourable circumstances the tramway plant appears to be charged with a large portion of the capital and standing costs of the lighting plant and actually earns a profit of £1,312 10s. per annum, which is appropriated for lighting purposes, whereas if the costs are equitably allocated, the actual cost of generation will be as follows:—

	£	s.	d.		
Standing Charges.					
Interest	210	12	0 = ·101d.	per unit	generated.
Sinking fund ...	140	8	0 = ·067d.	„	„
Management ...	158	10	0 = ·076d.	„	„
Rents, taxes, &c.	219	0	0 = ·105d.	„	„
Wages	273	0	0 = ·131d.	„	„
	1,001	10	0 = ·480d.	„	„
Running Charges.					
Fuel, &c.	1,041	13	4 = ·5d.	„	„
Oil, &c.	54	3	4 = ·026d.	„	„
Repairs	608	8	0 = ·29d.	„	„
	£2,705	14	8 = 1·296d.	„	„

In submitting the above figures, the author does not wish them to be regarded as model costs to be accepted as station records, as they would be proportionately lower in larger and better equipped installations. They are, however, intended to illustrate the application of the principles enunciated in this paper to actual working conditions.

Having ascertained in a given case the actual cost of generation, the percentage of profit to be charged on the supply may then be determined. It would be well for those responsible for combined stations, to see that the profit charged does not make the cost of the supply to the tramways undertaking too largely in excess of the amount for which the tramway people could generate their own current; or the chances are that this consumer will be lost to the station. In fact the advocates of the combined station, if they are to successfully combat the counter-proposals which are almost sure to be forthcoming from the tramways department, must be prepared to show that they can supply power for traction cheaper than it could be produced by a separate station. The author's contention is that this can be done and profitably.

Although some resident engineers may not look favourably upon a proposal to supply current for *any* purpose practically at cost price, and may recommend separate stations because of the greater amount of "management" required by the latter arrangement, and the consequently increased remuneration likely to accrue therefrom, local authorities can hardly be expected to accept such recommendations if, before doing so, they analyse them from a commercial and business standpoint.

INSTITUTION OF ELECTRICAL ENGINEERS.

STORAGE BATTERIES IN ELECTRIC POWER STATIONS, CONTROLLED BY REVERSIBLE BOOSTERS.

By J. S. HIGHFIELD, Member.

(*Paper read May 9th*, 1901.)

(*Concluded from Vol.* 48, *page* 1128.)

BATTERIES IN COMBINED STATIONS.

In combined stations, supplying both to a three-wire 460 to 500-volt lighting network and to a 500-volt tramway system, the boosting system can be used in a convenient way: 240 cells are sufficient with the booster just described for a tramway circuit at 509 to 550 volts, and are equally suitable for a 460-volt lighting system. Since no regulating connections are used two identical batteries may be installed, each working on to its own panel on the switchboard, the instruments consisting of a double-pole throw-over switch, a double-pole fuse, two voltmeters to show battery and line volts respectively, and an ammeter reading both sides of zero: leads should also go to the middle point on each battery, so that the middle point may be connected to the middle lighting bus bar when desired. By this arrangement either or both batteries may be used on the lighting or traction circuits, and one battery may be charged on either circuit and discharged on the other. In the event of no all-night cars being run, both batteries may be used to drive the lighting load.

A very great advantage of working batteries as described on traction loads is that an ordinary shunt-wound generator driven by an engine without any great weight of fly-wheel may be used, thus enabling the generators to be worked without alteration on the lighting bus bars, and saving the cost and complication of equalising gear.

It seems hardly necessary to point out how much easier is the work put on the running plant when batteries are used so as to give it a steady load, compared with driving the cars direct when all the fluctuations come on, and have to be dealt with by the engine.

GENERAL CONSIDERATIONS.

It is convenient to summarise the points referred to under the separate heads of:—

1. Batteries in lighting stations.
2. Batteries in traction stations.
3. Batteries in combined stations.

In the first case the battery should be used to serve as a regulator for the pressure, to enable the individual units to be fully loaded without the use of several graded sizes, and to enable the number of units to be decreased; that is to say, to enable a few units of greater and of uniform size to be adopted, instead of the many graded units usually installed, and to improve the plant load factor over the whole year, especially to enable the steam raising and distributing plant to be more uniformly worked; and, in special cases, to effect a saving in feeder copper, and to enable the area of supply to be economically extended.

In the second case, although the engines may be working only at one-third to one-half of their load, the boilers during working hours are economically loaded, and a battery will effect a saving of fuel, from the boiler point of view, by serving to operate the all-night load, shortening the boiler working hours, and ensuring that, when the engines are running, the boilers are working at a good load. The saving of one hour's steaming in the morning, and at night when only a few cars are out, will also effect a considerable saving in fuel. The battery, however, enables the engines to be run nearly at full load at all times, it thus makes the steam used per unit less, and also saves considerable wear and tear of plant; it enables, especially in small systems, a greater number of cars to be operated by a given plant, 20 light cars being easily worked by a 125-KW. unit. Used in sub-stations, the battery should effect a large saving in copper, both for line and rail feeders, it should frequently enable negative boosters to be dispensed with, and it permits of the working of long routes with direct supply at the standard pressure.

In combined stations the use of a battery worked in conjunction with a reversible booster enables all the plant to be of the same pattern, shunt-wound generators operating quite as well as compound ones. The arrangement of two identical batteries enables an interchange of energy to be made between the traction and lighting units, a point of value especially in stations of small and moderate size.

The special points to be considered in designing the battery, with a view to its economical use, are:—(1) The capital cost as compared with that of plant. For a lighting station this should be worked out at not less than the three-hour rate of discharge, and at this rate will be found not to differ much from that of plant of the same capacity.

For power stations the capital cost may be worked out at the one-hour rate of discharge, and will be less than the cost of corresponding plant.

The cost of battery depreciation is an exceedingly difficult figure to arrive at. I find that the cost of replating throughout for a battery in lead boxes, or in stout wood lead-lined boxes, amounts to about one-half the cost of the battery when allowance is made for old material. Giving the plates a life of six years, this represents about 7 per cent. per annum on the cost of the battery. Allowing for complete replating every six years, the repairs on a battery are a negligible amount, and the wages account is also exceedingly small, the labour involved being for filling up the cells every week or fortnight, and for taking the specific gravities every week as before described.

The chief considerations, therefore, are the saving in fuel due to working with a better load factor—especially working the steam-raising plant at a better load factor—the saving in wages through working the running plant a reduced number of hours; and, finally, whether the saving effected through these causes makes up for the cost of the lost energy in the battery itself.

From results obtained over a period of one year the efficiency of working under lighting conditions may be taken as 74 per cent., and, from the few figures I have, the efficiency under traction conditions is 84 per cent.

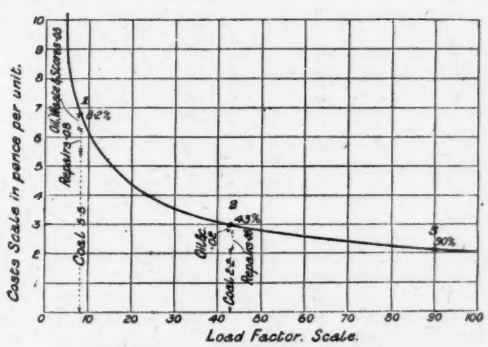

FIG. 18.—LOAD FACTOR AND COSTS.

Figures worked on basis of Lancashire coal at 9s. per ton. Load factor for points 1 and 2 = $\frac{\text{Units generated}}{200 \times 24}$. Point 2 is taken from a coal test over 48 hours with a Lancashire boiler 8 ft. diameter, 30 ft. long, steam at a pressure of 150 lbs. per square inch, superheated. Compound condensing engine 300 I.H.P. Coal used, 18,700 lbs. Units generated, 4,235. Total cost per unit, 4·44 lbs. Coal used in banking fires, 560 lbs. Point 1 estimated from this test; Point 3 from electrolytic works. The oil and stores and repairs are approximate.

I have found great difficulty in obtaining reliable figures as to the connection between the cost of coal, oil, water, stores and repairs, and plant load factor. I have, through the courtesy of the engineer of an electrolytic works, obtained the figure of ·21d. per KW.-hour for the above items on a load factor of close on 100 per cent. I have weighed the coal to one boiler operating a single engine driving the traction load over 16 hours, and, taking a low figure for the cost of oil and repairs at my station, I obtained the figure of ·3d. per unit for a load factor of 43 per cent.; the engine being 300 I.H.P., gave a fair load for a 30 ft. by 8 ft. Lancashire boiler using superheated steam. I obtained a third point on the curve by

calculation from this test, allowing for the coal used in banking and in keeping the steam pressure at not less than 80 lbs., the working pressure being 160 lbs. The load factor is arrived at by assuming that the engine and boiler could give 200 KW. steadily. I shall be very much gratified if the discussion throws further light on this question, and enables me to correct or confirm the curve fig. 18 plotted from the above figures.

It appears to me to be a matter of some difficulty to properly define the term load factor in this connection. Taking a single engine and boiler working at or near full load for a given number of hours, hours per day might be plotted on the horizontal line in fig. 18 instead of load factor. The ratio between time of working and costs would then depend chiefly on the length of steam pipes which it is required to keep hot when the engine is standing. But the case might be considered where the engine and boiler are working continuously but at various loads; the curve would then represent the efficiency of engine and boiler at these loads. With several engines and boilers the question becomes more complicated, and I find myself unable to come to any general conclusion, and I submit the curve for what it may be worth.

With regard to the arrangement of batteries, the present tendency to connect all the cells together by burning the lugs of the plates in each cell is undoubtedly excellent practice. The shorter and stouter these lugs are made the better will be the self-regulation of the battery. Cells of stout lead, or of wood solidly put together and lined with lead, are preferable to glass boxes on light wood trays. It is of great importance that the positive and negative plates should be designed to wear equally; if one set of plates have much greater capacity than the other the weaker ones will wear out first, causing greater expense for renewals. Watt-hour meters for measuring the charge and discharge should form part of the equipment of all batteries; even daily charging and discharging are essential to the life of the plates, and if the daily input for a lighting battery is 25 per cent. more than the output, weekly readings of the specific gravity will show if the charge is right.

The energy efficiency obtained of 74 per cent. on the lighting battery is certainly due, in part at least, to the great ease of operating attained by the methods described.

The increased efficiency observed when the battery is worked as I have described, on an intermittent load, is interesting. It appears to be due to the fact that the discharges are often of such short duration that the increased pressure due to the gas effect is utilised on these discharges. The fact that the battery alone "floating" on the line operates best when the working pressure of each cell is taken at about 2·08 volts seems to confirm this view.

In conclusion, I must apologise for the somewhat tentative way in which I have put forward my views; my excuse is that there are so many variables in considering battery working that it is not easy to find a starting-point from which to calculate. I have to thank Messrs. Elliott Bros. and the British Thomson-Houston Company for lending me several instruments, and my assistants, Messrs. Hollingsworth, Eccles and Carter, for helping me with the experimental work.

APPENDIX.

Complete Figures Relating to an Electric Power Station Driving a Tramway and General Supply Load.

The figures relate to the period from March 31st, 1900, to March 31st, 1901.

		April to June.	July to Sept.	Oct. to Dec.	Jan. to March.	Year's Total.
Units genr.	Lighting	58,938	64,350	122,924	124,907	371,119
	Traction	120,477	144,562	182,058	194,662	641,759
	Total	179,415	208,912	304,982	319,569	1,012,878
Units sold	Lighting	47,620	53,845	102,410	105,382	309,257
	Traction	118,407	132,041	168,008	183,229	601,685
	Total	166,027	185,886	270,418	288,611	910,942
Batteries (1)	Charge	27,110	31,640	30,920	32,493	122,163
	Discharge	19,680	24,120	22,270	24,810	90,880
(2)	Charge	—	—	Mar. 2nd to 31st only.	10,517	—
	Discharge	—	—		8,560	—
Booster motor units		From Aug. 22nd only.	2,660	6,194	5,720	14,574
		KW.	KW.	KW.	KW.	KW.
Max load on feeders	Lighting	180	216	278	250	278
	Traction	307	344	402	430	430
	Total	482	560	638	660	660
Max. load on plant	Lighting	194	195	292	220	292
	Traction	206	302	212	255	302
	Combined	390	470	504	475	504
Plant hours	Lighting	670	614	1,304	1,391	3,988
	Traction	1,455	1,418	1,410	1,451	5,734
	Combined	1,455	1,418	1,410	1,451	5,734
Load factors	Lighting	12·1	11·8	17	19·4	12·7
	Traction	17·5	17·8	19·0	19·6	16·2
	Combined	15·9	15·1	19·4	20	15·8
Plant load factors	Lighting	45	53	32	41	32
	Traction	41	33	60	52	37
	Combined	31	31	43	46	35
Percentages. Lighting	*Sold* Gener.	80·8	83·6	83·3	84·3	83·3
	Charge Gener.	46·0	49·1	25·1	26	33
	Disch. Sold	41·3	44·8	21·7	23·6	29·4
	Disch. Charge	72·6	76·2	72·0	76·3	74·4
Traction	*Sold* Gener.	93·3	91·3	92·3	94·1	93·7
	Booster Gener.	—	—	3·40	2·94	3·30
	Charge Gener.	—	—	From Mar. 2nd to 31st only.	16·02	—
	Disch. Sold	—	—		14·0	—
	Disch. Charge	—	—		81·4	—

The tramway system was very rapidly extended throughout the year, as is shown by the figures; the consequence is that the load factor over the whole year is lower than will be the case next year, when less new work will be done; the load factors for the quarters give a more true idea of the correct figures.

The boilers under steam at any time were two Babcock boilers fired with refuse burnt in a destructor, and two 30 ft. × 8 ft. Lancashire boilers, say the equivalent of three 30 ft. × 8 ft. Lancashire boilers.

Table II.—Showing Capacity of Battery and Plant in some Direct Current Stations.

	Total capacity in kilowatts.		Ratio of battery to steam plant in KW.
	Plant.	Battery at 3-hour rate.	
Aberdeen	1,620	260	·16
Sunderland	1,880	60	·03
Norwich	1,664	120	·07
Notting Hill	660	100	·15
Oswestry	173	40	·23
Wolverhampton ...	1,440	220	·15
Manchester	7,250	240	·03
Lincoln	600	85	·14
Chester	1,000	30	·03
Charing Cross	4,900	800	·16
Chelsea	3,100	190	·06
Stockport	460	250	·54
Whitehaven	210	55	·26
Canterbury	300	150	·5
Leyton	1,260	200	·15
Hove	1,200	90	·07
Barrow	525	40	·07
Halifax	1,900	200	·1
Nelson	116	88	·75
St. Helens	950	230	·24
Northwich	194	66	·34
Leith	640	115	·18
Llandudno	400	60	·15
Hull	3,900	300	·07
Bradford	3,569	270	·07
Burnley	822	120	·14
Shrewsbury	540	60	·11
Bury	760	70	·09
Kensington	1,000	157	·157
Edinburgh	9,697	460	·048
Dewsbury	485	85	·175
Southampton	730	250	·34
Belfast	2,200	200	·09
Harrow	350	70	·2
Stafford	198	140	·7
Nottingham	2,569	30	·01
Blackburn	2,127	75	·03
Glasgow	10,848	468	·04
Guildford	200	66	·33
Dundee	1,283	248	·19

India.—*Indian Engineering* says that a report has been called for on the subject of the practicability of lighting the R.I.M. Dockyard at Kidderpore with electricity.

STREET LIGHTING FROM THE MUNICIPAL COMMITTEE'S STANDPOINT.

The "Notes" on this subject contributed by the convener of the Glasgow Electricity Committee, Bailie Maclay, to the Municipal Electrical Convention are interesting as coming from the representative of those who pay the bill, and therefore may be expected to "call the tune." Engineers have exhaustively treated the subject from different aspects. Bailie Maclay's is practically the ratepayers' reply to Mr. Corbet Woodall's effusion of a few months ago,* as an extract from that address is attached as an appendix to the paper.

The reply is very much to the point. The steady and rapid improvement in the standard demanded for street illumination is credited directly to electricity, and, in support of this, the lighting of the City of London is cited. Until electric lighting was introduced, 2 and 4-ft. burners were common; then came the early experimental lighting, next the reversion for a time to gas with larger burners in increased numbers, and finally the reinstatement of arc lighting. The higher standard of illumination is due to electricity having "forced the pace," and the cry for more light is a refutation of the suggestion that the days of electric lighting are numbered. The general opinion in Glasgow seems to be that after effective sanitation the thing that is absolutely necessary is efficient public lighting, and to offer bad lighting in order to save money is to waste both. Incandescent gas lighting, while the mantles are new and during calm fair weather, is an enormous improvement over the ordinary flat flame burner, but entails extra expense for renewal and upkeep of mantles and other accessories. At the same time in streets with heavy traffic the mortality is considerable, and in suburban London it is found cheaper and better in many instances to increase the number and size of flat flame burners (now usually "4·6 ft.") in preference to mantle burners being fitted on existing posts. One Metropolitan Borough Council has increased its gas lighting bill by over £200 per annum by the improvements effected in side street lighting since November last. These facts corroborate the assertion that for main thoroughfares where a really brilliant illumination is desired, incandescent gas cannot in any way equal, far less surpass, electric light. The Great Western Road, in Glasgow, is one of its most important residential and radial thoroughfares, giving access to the districts of Hillhead and Kelvinside, and when the lighting was considered it was found impossible to produce an equal standard of illumination with electricity at any reasonable cost by gas mantles on the centre trolley poles at 40 yards apart, unless side lamps were introduced at intermediate points and even then the cost of equal illumination would have been far greater without taking anything off the nominal power of the mantles for deterioration. It was ultimately decided to place the electric lamps at a height of 27 ft. to the arc, using 7 to 7½ ampere arcs giving about 700 c.p. These lamps are charged £12 per annum each for all-night burning, covering maintenance, carbons, trimming and cleaning, but not interest and sinking fund on the capital outlay. 10-ampere lamps are rated at £14 per annum each. The cost worked out at about £500 per mile of street in Edinburgh, with lamps 40 yards apart, while the cost of lighting had gone up from £3,200 to £11,000 per annum, with an increase of from 25 to 30 times more light. Mr. Newington, of Edinburgh, has stated that in his opinion £13 per lamp annually is the lowest possible charge where half are turned out at midnight, and on this a loss of a few shillings is made. Bailie Mackenzie, of Edinburgh, considers that unless the public is prepared to pay three times as much for street lighting by electricity as for gas the change should not be made; all main thoroughfares should be so lighted, even if side and unimportant streets are not. An incidental advantage is the result of competition; thus Alderman Pearson, of Bristol, mentions that the gas company has reduced the charge for lighting to a very low figure, and indirectly the better and cheaper lighting of the side streets has been secured. Alderman Ivey, of West Ham, raised the important consideration of incidence of rating, and pointed out that it is unfair to light the main streets at a low cost, using arc lamps, because the value of the better class shops was improved at the expense of the shopkeepers in the side streets, and a preferential rate was created in favour of the occupiers on main thoroughfares.

Bailie Maclay alludes to the objection sometimes made that arc lamps give patchy lighting, the illumination being brilliant for a certain distance round the lamp, and of low value midway between adjacent lamps. This is necessarily the case with any form of lighting, but the objection is more sentimental than real, for, as Mr. Wordingham pointed out, people are apt to judge by the apparent brightness of a row of lamps, whereas the proper way to judge is to look at the roadway, or to turn one's back on the lamps and ascertain at what distance a railway time table can be read without discomfort. It is a pity, we think, that more general and systematic measurements of street lighting are not made with portable street photometers or "candle-feet measurers." Where this is done the figures tell a more reliable story than any eye guesswork, and photometry is worth more than pupilometry. The energies of the gas engineer are being devoted to the production of a gas mantle which will give as large, concentrated, and brilliant a light as the arc, and this goes entirely to disprove the assertions so freely made that gas men believe the incandescent mantle to be a satisfactory and permanent rival to the electric light.

The height for the arc seems to have settled down at about 20 ft. above the roadway, and the distance apart at 40 to 60 yards. Mr. Wordingham does not agree that the lamps should be placed very high up, as then vertical surfaces are not well lighted, but Mr. H. T. Harrison replied to this by showing that the higher the lamps the better would be the distribution of light. Anyone in London can test this for himself, taking Euston Road, where, we believe, the lamps are 25 ft. high, and comparing the distribution with the more common posts of 20 ft. or so. Blondel's and A. P. Trotter's writings on the subject should be studied by engineers having to design street lighting arrangements, as only thus could the problem be mastered in its technical aspect.

There is no doubt that although it is difficult to show on paper any commercial advantage for the electric incandescent lamp over gas for side street lighting, the public prefer the former. Brighton is the best example, but places like Bexhill with its Prism globes, and High Barnet with occasional Reason fittings, Ilford and many others prove that the incandescent lamp meets the public taste. Plymouth thinks its gas incandescent hard to beat: at Tunbridge Wells two 16-c.p. electric lamps cost £3 7s. 6d. per annum, against a 50-c.p. gas incandescent at £3 17s. 6d., while Taunton gives £3 yearly against £2 17s. 6d. charged for similar lighting by the Gas Company. The gradual extension of side street lighting in London is a conclusive proof that whatever the commercial arguments may be, the conversion is regarded as an improvement, and an upward step, the public are desirous of such changes, and seek them; and as electrical energy is on the downward tendency as regards cost, the price charged for street lighting will render the competition keener and sharper, there being little doubt as to the ultimate universal adoption of electricity.

* See Electrical Review, p. 486, March 22nd, 1901.

THE TWO RICHMONDS.

By an Observer.

The Institution of Electrical Engineers—originally the "Society of Telegraph Engineers"—was founded in 1871. It tacked on the "Electricians" ten years afterwards, dropped out the "Telegraph," and assumed its present name at the close of 1888.

The objects of the Association are comprehensive enough, viz., "To promote the general advancement of electrical and telegraphic science and its applications, and to facilitate the exchange of information and ideas on these subjects amongst the members of the Institution and otherwise."

In 1895 a second Richmond entered the field in the shape of an Association, not necessarily intended for promoting the general advancement of the industry, but for the protection and defence of the rights or interests of municipal electrical undertakings.

The business of the Association is not exclusively technical, as its members include municipal electrical committees, most of whom are probably ignorant of the science of electricity, and many of them opposed to its development.

It is, in fact, an association formed for promoting municipal trading in electricity and opposing private enterprise, in order to control the business, and, if possible, establish a close monopoly in the hands of the local authorities.

So far as the electrical engineer is concerned there are no advantages that he cannot obtain in the older Institution, with the obvious disadvantage that as membership is limited to those engaged in municipal undertakings only, they must go to the Institution of Electrical Engineers, which is open to all, for the fullest information and discussion upon the points in which they are interested.

The non-technical members form the most numerous body of the Association—viz., the 92 lighting committees, who will amount to probably 1,250 persons, the engineers numbering 159—so that in matters of policy referred to the members a very decided majority belongs to those unacquainted with engineering matters, and although each committee would only have one vote, the engineers would find their engine rooms above the normal heat if they ventured to vote against their committee.

If the Association were limited to the engineers, and the Gas and Lighting Committees were eliminated, we can imagine many useful subjects for discussion—*inter alia*, the interference of councillors with the working of the station, delay in adopting suggestions of the engineers and in finding money for them when approved, street lighting by electricity instead of gas; even the question of their remuneration might be settled, although this would be verging upon the principles of trades unionism which the rules of the Association would clearly limit to the municipalities themselves.

Meanwhile the Association is by no means an unmixed blessing so far as the progress of the electricity supply is concerned.

The action of the Association in opposing the Power Bills of last session is a case in point. It will be remembered that one Bill—that of the North Metropolitan Electric Power Supply Company—was actually read a second time in the House of Commons without opposition, and referred to an ordinary committee, but all the other Bills were hotly opposed and referred to a special committee. The cause of this was, no doubt, due to the fact that the Municipal Electrical Association took no action in the case of the Metropolitan Bill, but used all their influence in stirring up Parliamentary opposition to the provincial schemes.

The political power of a combination of local authorities is undoubtedly very great, and when directed against commercial enterprise is most pernicious to the interests affected.

The remedy is in the hands of the ratepayers, who appear to be slowly realising the fact that speculation in a technical businesslike electricity supply is not conducive to their interests. When they understand the question, their opinion is unmistakably expressed—as in the recent poll of the ratepayers of Tonbridge upon the scheme of the Urban District Council to carry out their electric lighting order—the votes recorded being:—

For the scheme...	187
Against	1,878
Neutral...	244

and in the larger scheme of the combined local authorities of North London, which was out-voted by immense majorities when the vote was taken at Enfield and Edmonton under the provisions of the Borough Funds Act.

The papers read at Glasgow were naturally limited to subjects supposed to be within the grasp of the average town councillor, such matters as "wiring rules" and other technical questions being left to the older Institution.

Practically speaking, the "Incorporated Municipal Electrical Association" has no *raison d'être*, so far as the electrical engineer is concerned. It is really intended to promote municipal trading in electricity supply and encourage opposition to private enterprise. Powers are obtained in many cases without any intention of working them, but merely to keep companies out, or to create an asset which can be dealt with subsequently.

The gas interest is largely represented in the Association. In some cases where gas is supplied by the local authority, the membership consists of the "Gas and Electric Light Committee."

The political action is doubtless more or less inspired by the officials of the municipalities, aided by the consulting electrical engineers, and not necessarily in the interests of the ratepayers.

The municipal electrical engineer may possibly derive little advantage from these conferences; he runs the show under many difficulties, which naturally follow the control of an elective body unacquainted with the business.

ALLOCATION OF COSTS IN COMBINED LIGHTING AND TRACTION STATIONS.

Mr. Tittensor's paper read at the recent meeting of the Incorporated Municipal Electrical Association at Glasgow deals with a question of accountancy, but involves also important matters of principle.

In the first place, should local authorities trade at all in the supply of electricity? And if they do, are they to adopt the ordinary commercial principle of working for a profit, or to act upon Mr. Tittensor's belief that supplies of a *purely public nature* should be given at *cost price*?

Common sense (unfortunately a most uncommon commodity) would contend that it is altogether unsound for anyone to embark in a highly technical business without knowledge or capital, dealing in an article which is not absolutely necessary nor in universal demand, and yet this is the position of the local authority which embarks in electricity supply at the risk of the ratepayers, nine-tenths of whom may never use the energy.

As a matter of fact, the number of consumers of electricity has not exceeded 10 per cent. of the ratepayers even in towns where it has been supplied during 10 years and upwards. The only advantage therefore that can arise to the ratepayers as a whole is by trading at a profit in order to reduce rates.

We doubt if any members of town councils would think of embarking the town in an electric supply speculation—except on the cry of appropriating for the ratepayers the profits which the companies may make if private enterprise is allowed to undertake the business.

But Mr. Tittensor appears to distinguish between what he considers supplies of a purely public nature, such as public street lighting, sewage pumping, tramways, &c., and the demands of private consumers, who are not to consider the local authority as a "philanthropic institution," so that it is out of them that all the profits are to be extracted.

We hardly think the author of the paper should class tramways as being purely of a public nature—like the public lighting or sewage pumping—for while the two latter are absolutely for the advantage of the whole community, the former are limited to those who ride in them, and pay for the accommodation. Tramways should be treated like the supply of electricity to the private consumer, and the profits given to the ratepayers, the electricity required for the traction being paid for like the rest of the necessaries of working. The local authority should not be expected to sell on philanthropic principles.

But it is very difficult to work on a system of cost price in one department, and a profit in another, and if we are to have all this business undertaken by municipalities, supplies from one department to another must be at actual cost, all profits being derived from the charge made to private consumers of electricity or passengers in the tram cars, as the case may be.

We know that the Electric Lighting Committees have often tried to make both ends meet by excessive charges for the street lighting, making a considerable profit, which has

been applied to covering the deficiency in the general running of the stations.

The advantages of a combined station for supply of electricity for light, power and tramways are numerous, but as the accounts of each undertaking must be kept separately, the tramways must be treated as customers of the supply undertaking, and the price for current must cover standing and running charges. If neither profit nor loss is to be made, it will necessitate a very careful adjustment of the accounts to arrive at the actual cost of the current delivered into the tramway cables, and it may be found both equitable and more practicable to charge a fair market price, including a margin for profit, to be paid out of the surplus derived from the passenger traffic.

Mr. Tittensor's calculation of standing and running charges is not clear. He places wages, for instance, as a standing charge, instead of classing it with the fuel and engine room stores. Standing charges are independent of the quantity of energy generated, whereas wages depend, of course, upon the work being done.

If the current supplied to the tramways department is to be charged at cost price, there will naturally be no question of the price being in excess of the amount at which the tramway people could generate their own current, as the combined supply for all purposes should be cheaper in any case.

The combined station has other advantages besides the mere cost of current. By arranging, for example, that the cables be laid in the same trenches for all purposes, there is less cost and disturbance of the streets, and generally greater convenience in working the supply. There is also an economy in management by combining the two businesses under one general organisation, while the improvement in the load factor by the all day demand necessarily tends to a general reduction in costs, by the fuller employment of the plant and the better return on the capital invested.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

12,329. "Improvements in electric motors." A. O. FOX. June 17th. (Complete.)

12,342. "Improvements relating to electro-magnetic winding mechanism for clocks." T. SCHAFFER. June 17th.

12,350. "Improvements in revolving electric igniters." A. G. RONAN. June 17th.

12,382. "Improvements in portable electrically-driven drilling apparatus." G. F. CAMPBELL AND S. T. ISHERWOOD. June 18th.

12,400. "Trolley for electric cars." J. LIDDLE. (Laclede Car Company, United States.) June 18th. (Complete.)

12,403. "Improvements in bonding electric railway and tramway rail joints." J. S. HOLME. June 18th.

12,408. "Improvements in and relating to static rectifiers and other electrical apparatus for producing or maintaining continuous or unidirectional discharges." T. B. KINRAIDE. June 18th. (Complete.)

12,456 "Improvements in or relating to trolleys for use in electric traction." J. G. LISTER. June 18th.

12,466. "Improvements in apparatus for deriving continuous current from a source of alternating current." SIEMENS BROS. & Co., LIMITED. (Siemens and Halske Aktiengesellschaft, Germany.) June 18th. (Complete.)

12,469. "An improved current transformer for telephones." B. J. BERTHELON. June 18th.

12,495. "Seeing by electricity." L. FRANCKEL and R. R. HARPER. June 19th.

12,508. "Improvements in apparatus for deriving continuous current from a source of alternating current." SIEMENS BROS. & Co., LTD. (Siemens & Halske Actien Gesellschaft, Germany.) June 19th. (Complete.)

12,509. "Improvements in apparatus for deriving continuous current from a source of alternating current." SIEMENS BROS. & Co., LTD. (Siemens and Halske Actien Gesellschaft, Germany.) June 19th. (Complete.)

12,514. "Improvements in or connected with storage or secondary batteries." J. C. FULLER and G. FULLER. June 19th.

12,551. "Improvements in and relating to trolley pulleys for electric tramcars and the like." R. WYLIE. June 20th.

12,552. "Improvements in electric arc lamps." CROMPTON & Co., LTD., A. J. HODGSON and J. W. EWART. June 20th.

12,587. "Improvements in and relating to apparatus for lighting and heating by means of electric lamps." R. W. BOYD. June 20th. (Complete.)

12,607. "Improvements in and relating to plates for electric batteries and methods of manufacturing the same." E. B. VILES. June 20th.

12,622. "Improvements in electric instruments." EVERSHED & VIGNOLES, LTD., and S. EVERSHED. June 20th.

12,685. "An improved method of registering electric currents." S. JEVONS and E. W. BONSON. June 21st.

12,691. "Improvements in electric cloth-cutting machines." R. E. LEVE, June 21st. (Complete.)

12,720. "Improvements in or connected with electric cables for three-phase alternating currents." W. B. ESSON. June 21st. (Complete.)

12,721. "Improved machine for use in the manufacture of electric fuses or cartridges." H. TIRMANN and H. TIRMANN. June 21st. (Complete.)

12,730. "Improvements in cleats, ceiling roses, cut-outs, and the like, for electrical purposes." C. C. METCALFE. (H. C. Blackwell, Russia.) June 22nd.

12,739. "Improvements in electrically-driven centrifugal and similar machines." G. POTT and R. WILLIAMSON. June 22nd.

12,755. "Improvements in electric motors." J. MATTHEWS and W. DAVIES. June 22nd.

12,761. "Improvements in submarine cables." J. JOHNSTON. June 22nd.

12,770. "Apparatus for automatically regulating the tension of electric currents." O. IMRAY. (M. Lindner, Austria.) June 22nd. (Complete.)

12,773. "Improvements in wattmeters." J. BATLLE and J. BUENO. June 22nd. (Complete.)

12,774. "Improvements in cell-switching devices for electric accumulator batteries." M. GEHRE. June 22nd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

20,068. "An improved ohm-meter or apparatus for directly indicating resistances." C. Beez. Dated October 6th, 1899. Relates to resistance meters. A galvanometer capable of measuring a few mill-amperes, is connected in series with a source of constant current, a rheostat and a resistance, which may be either a 1,000-ohm or a higher resistance to be measured. The rheostat is adjusted so that the galvanometer gives its maximum reading with the standard resistance in circuit. The resistance is then substituted and the diminished deflection of the galvanometer then indicates the amount of this resistance, the galvanometer being specially graduated. 2 claims.

20,084. "Improvements in the method of, and means for, transmitting and receiving electric waves for the production of signals and for imparting motion to machines or apparatus." J. C. Saviera. Dated October 6th, 1899. Relates to a method and apparatus for utilising Hertzian radiations for telegraphs, firing mines and torpedoes, and controlling the motion of machines or apparatus generally. The arrangement of transmitting manipulator is described by which prearranged series of waves are sent. The apparatus is described for telegraphic purposes, and consists of a conducting plate, one surface of which is coated with insulating material, excepting where conducting portions protrude in lines representing the Morse code. The plate is connected to the relay and battery, a style of contacts operated by keys being moved over the contacts to complete the local circuit. The manipulator relay is connected to a source of energy such as an induction coil, alternating generator, or battery of Leyden jars, and the oscillator spheres are arranged in the open air. In the receiving apparatus, or coherer, two metal plates having protruding shanks are clamped together by discs, &c., and contain between them a sensitive plate. The two metal plates may be whole or may be divided, the adjacent edges being serrated and nearly in contact. The plate may consist of gelatine containing metal filings and powdered carbon, the mixture varying from the centre to the edges. The sensitive plate may be surrounded by a flexible bag or edging, or may consist of an ebonite plate having a central, preferably triangular, aperture. The gelatine may be replaced by alcohol, glycerine, or oil. A series of the discs may also be employed. The coherer is mounted on glass plates, upon which a restoring tapper may act. The aerial conductor preferably contains a horizontal portion, which is provided with one or more vertical extensions. Adjustable resistances consisting of carbon cylinders with adjustable metal clamping ends, are also described. 14 claims.

20,100. "Improvements in suspension fittings for electric lighting systems adapted to high voltage." M. Rolling and J. H. Collings. Dated October 6th, 1899. Relates to supporting lamps. A ball fitting is made in halves, which screw together, and are connected electrically by spring plungers carried in recesses in an insulator, in one half bearing on circular and central blocks, supported similarly in the other half. The circular block may be divided into segments when more than two connections are to be made, corresponding spring plungers being provided. The plunger carriers and the blocks are provided with screws to secure the supply and lamp wires. The insulator carries an S-shaped projection between the plungers. 4 claims.

20,110. "Improvements in electrical accumulators." F. Loppe, H. P. Morin, D. P. Martin, G. J. A. Grimer. Dated October 6th, 1899. (Date under International Convention, April 1st, 1899.) The support for the active material is made up of a number of thin lead plates, perforated with a number of small holes, which are preferably of conical shape, the metal protruding around one edge. The plates are also undulated or corrugated. The plates may also be made of lead network, or may be in the form of grids. The plates may be a number of separate pieces fastened together by tubular rivets, or by soldering, or may be formed by folding a single sheet several times. Additional openings to those described above are made in a perpendicular or oblique direction through the plates and the separators to facilitate the circulation of the electrolyte. The thin plates of each electrode are kept apart by distance pieces. Each pair of electrodes may be separated from the others by a plate of insulating material perforated with holes which coincide with the openings in the electrodes. Several electrodes and separators are bound together in a single block by means of rubber rings which encircle them. 3 claims.

20,121, "Process and apparatus for the production of insulators for electric wires." F. Kapfenberger. Dated October 6th, 1899. Relates to the casting of insulators for electric wires at a single operation. A two-part mould is furnished with a recess corresponding to the external form of the insulator to be made. A core is inserted at the base of the mould, and a second core, detachably secured to the cap, is passed through the core (first). The composition is poured in, and when it is partially dried, the second core is screwed out by means of the spindle, which has the same pitch as the thread of the core. Insulators provided with buttons and ears may be similarly cast. 2 claims.

20,124. "Improvements relating to means for electrically controlling gascocks and lighting gas burners." R. Haddan. (La Societe Anonyme "Lux Nova.") Dated October 9th, 1899. Relates to electrical apparatus in which separate electro-magnets and circuits are employed for lighting and extinguishing the gas, and in which the valve and the sparking device are simultaneously actuated, the spark igniting the main burner and not an auxiliary burner or pilot jet. When the current is passed through the electro-magnet of the lighting circuit, the armature actuates the lever and opens the gas cock, and the insulated disc lifts the rod and breaks the circuit at the sparking points. When the current is passed through the other electro-magnet, the armature actuates the lever in the reverse direction and cuts off the gas. Leakage of gas from the plug cock is prevented by an adjustable spring which presses upon the large end of the cock. 3 claims.

20,145. "Improved combination electric light fittings." W. Savenacks. Dated October 7th, 1899. Supporting lamps.—An electrolier consists of a central body portion which may be suspended or fixed on a wall, and has slots to receive corresponding projections on curved arms, these being fixed by turning them into working position. The slots are oblique, so that the arms may be directed either upward or downward. Ends may be screwed on the arms to carry suspended lamps or obliquely-fixed lamps, or candle sockets. The arms are wired before being attached to the central body; the wires are connected by binding screws to two rectangular or circular metal plates, insulated in separate boxes or a grooved disc in the central body and attached to the supply wires. Slots in

the central body not occupied by arms are closed by blank pieces. The arms can thus be used in varying numbers and for supporting lamps in different ways, and are portable. 7 claims.

20,214. "Improvements in or connected with electrolytic bleaching of haled yarns." A. A. Vogelsang. Dated October 9th, 1899. In the electrolytic bleaching of cotton yarn, a large number of bundles or bales are bleached at once and without being unpacked. To permit of this, the bundles are placed vertically in the bleaching vat, so that the circulating fluid may move in the direction of the threads. 1 claim.

20,216. "Receiving apparatus for high-speed telegraphy." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft.) Dated October 9th, 1899. High-speed telegraphy in which the messages sent automatically are recorded by means of a photographic impression of the various types illuminated by a ray of light, the part of which is controlled by one or more mirrors. The specification is too complicated for purposes of abridgment. 2 claims.

20,227. "Improvements in and connected with the collectors and conduits for electric tramways." A. M. Taylor. Dated October 9th, 1899. Electrical railways and tramways on the conduit system, with conduits such as are described in the Specification, No. 4,727, A.D. 1899, and means for picking up, dropping, or changing the ploughs in case of obstruction or of change to overhead conductor or lever conduits. Correctors, conduits.—The plough consists of two conducting strips connected by globe strain insulators or blocks of wood or other insulated and provided with U-shaped joints to give flexibility. The forward parts are tapered to force in the contact plugs described in the prior specification, and are also provided with a guiding wheel, and in some cases with an inclined nose to clear the slot of obstruction. A brush and scraper, &c., may be attached to the plough, or may be carried by the vehicle to sweep out the conduit. This collector is carried by shanks which have heads tapered at each end, and these heads are received in the ledges inside the "picking-up box," where plungers make contact with the leads from the sides of the plough, but springs or other contacts may be used. The box is supported from the vehicle by parallel motion links, which may also be mounted on a verticle axis to give lateral as well as vertical play. The head of the shank may be prevented from slipping out of the box by a spring-held flap at the back which opens in case of obstruction or at the will of the driver. Or the same object is obtained by a link with a breakable connection engaging the nose of the plough. This link has a curved looped-shaped head to allow of rounding curves, and it can be raised or lowered from the vehicle. When an overhead conductor section is reached, the slots of the up and down lines run together, and the plough is dropped or picked up there. At the junction, a pivotted tongue opens one or other of the slots, and a guide plate underneath is thrown over to the same side but rather further by means of a pin-connection placed beyond its pivot. When different sections of conduits are used on the line, a collector may be employed. In this form rubbers to work on continual conductors are shown on bars which are carried by links from the upper collecting bars. Extensions of the bars are provided with rollers which engage guides at the junction of two forms of conduits, so as to raise or lower the under collectors. When raised, the latter lie between the upper bars and may be held by catches, and the pivots which connect the various parts are provided with cams which cause the lower bars to spread when lowered. To increase the length of the leakage path, the conduit may be lined with wood and aprons of flexible insulating material supported by guard plates and provided with rubbing pieces are attached to the collector so as to enclose the conducting parts. 17 claims.

20,237. "Improved method and apparatus for the manufacture by electro-deposition of articles plated with platinum, gold and silver." L. Bourdillon. Dated October 9th, 1899. Copper and silver depositing.—Articles formed of thin platinum or gold with a backing of copper are made by first winding a sheet of thin platinum or gold around an aluminium drum, or by attaching such a sheet to one or both sides of a plate. In the first case, curved copper anodes and a brush are used, the electrolyte being agitated by paddles on the axle of the drum. In the second case, the anodes are perpendicular, and the cathode is given a to-and-fro movement. For backing thin platinum crucibles and other formed articles, the crucible, &c., is filled with tinfoil, solder, &c., and then closed with a stopper through which a conducting-rod passes. Silver or several layers of different metals may be similarly deposited. To prevent an ordinary polished silver deposit from adhering to the cathode used, a current of great intensity and high tension is passed at the commencement of the operation. For a dull surface, the mould is coated with a soluble or insoluble conducting material, such as plumbaginous grease. When depositing on relief surfaces, *e.g.*, cooking-utensils or coils, the mould is formed of a fusible alloy, which will crack off if placed in boiling water. 5 claims.

20,277. "An improved electrical selector switch." A. Eckstein and H. J. Coates. Dated October 10th, 1899. Switches for telephone or telegraph circuits. The contact lever is adapted to be moved to make contact with either of the studs, which are suitably marked or labelled. The studs are grooved to receive the end of the lever or a spring carried by the lever. 2 claims.

20,280. "Appliances for imparting electricity and heat to the body." J. Timar. Dated October 10th, 1899. An india-rubber bag with a neck and stopper is filled with crystallised sodium acetate or thiosulphate, or barium hydroxide, which is melted in its water of crystallisation, and the heat given out on re-crystallisation is used to warm the body. The bag is fitted in the turned-up edges of a metallic netting or plate, which is provided with a terminal for an electric current. A plate may serve as the cathode, or a second terminal may be provided on the plate, &c., which may have an interrupting layer to cause the whole of the current to enter the body. 2 claims.

20,288. "Improvements in and connected with electrical indicating and measuring instruments." M. Waddell. Dated October 10th, 1899. A coloured liquid in a gauge glass is used as an indicator, with an adjacent scale. The lower end of the glass communicates with a liquid receptacle, the upper end of which may be either closed or open to the atmosphere. The upper end of the glass and a connected channel contain air under a pressure varying inversely to the electric current to be measured, the height of the liquid column being thus varied. For this purpose, air under constant pressure is supplied through an inlet to an air-flow resistance, such as a coil of capillary tubing, from which it enters the channel, while air may escape from the channel by a valve controlled electro-magnetically. The valve is a small disc, held down on the flat end of the escape tube by a lever which can oscillate vertically to a small extent, determined by stops. The lever is supported by a horizontal cross-piece carrying two clamping plates below similar clamps on stationary supports, and two small flexible metal strips secured in these clamps. The strips and clamps convey the current to be measured to a small cylindrical coil on the lever. Counterbalance weights are screwed on the lever. The coil is situated in a magnetic field between a round leg of a permanent magnet, and a surrounding iron block attached to the other leg, and is thus electro-magnetically moved vertically when current passes. In modifications, the magnet, lever, and valve may be placed in an air-tight cover from which the air is constantly exhausted, air being admitted to the inlet at atmospheric or other pressure. The gauge-glass and liquid receptacle may be replaced by any other kind of air-pressure gauge. 22 claims.

20,316. "Troughs for electric cables." W. Sykes. Dated October 10th, 1899. Conduits are formed of open stoneware troughing, either single or multiple. The conduits are formed with an internally rabbeted upper portion, to receive a cover of cement and sand or bricks after the conductor has been set in bitumen up to the rabbet. The lengths fit together with spigot-and-socket joints filled in with bitumen, a stud or shoulder extending part of the way round the socket keeping the two lengths in alignment. 1 claim.

20,321. "Improvements in the construction and arrangement of electrical resistance coils." W. G. Pye. Dated October 10th, 1899. Resistance coils for testing or other purposes are wound on bobbins provided with handles and metal connecting-plates, which can be inserted between plates fixed on a base, or can be turned so as to directly connect the adjacent plates. In one arrangement the bobbin-plates are semi-circular, with tapered extensions which enter holes between the fixed plates. In another arrangment, when the bobbin-plates are in place, they are pressed up against the fixed plates by non-conducting projections on the bobbins bearing on plates on springs; the fixed plates are raised on insulators set in grooves in the base, and the springs are supported in holes in the base by a bottom plate. In Post Office resistance boxes and bridges only two gaps are necessary in the proportional arms, as coils of any resistances may be inserted. 6 claims.

20,328. "Improvements in or relating to dynamo-electric generators or transformers." J. K. Robison. Dated October 10th, 1899. Relates primarily to dynamo-electric generators for supplying unidirectional currents to a working circuit without the use of commutators and consequently without sparking. The machines partake of the nature of rotary transformers, and may be used for converting single or multiphase alternating currents into unidirectional currents or *vice versa*. The invention consists essentially in winding the field magnets of the generator in such a manner as to produce an alternating polarity, and exciting them by means of alternating currents, while the armature is rotated at such a speed that the number of field poles multiplied by the number of revolutions per minute is equal to the number of alternations per minute of the exciting current. A simple form of the apparatus consists of a bipolar generator in combination with a bipolar alternating current exciter. The field coils of the generator are connected in series with the armature of the exciter, while the shunt and series field coils of the exciter are connected with the armature of the generator and with the supply mains. Both armatures may be mounted on the same shaft, or their shafts may be geared together, so as to ensure synchronous rotation, and the armatures are rendered capable of angular adjustment relatively to each other by mounting them on sleeves secured to the shaft by set screws. A secondary battery arranged in a branch circuit may be employed for starting purposes, or it may be used for exciting the generator when it is required to supply alternating currents. Switches are provided for throwing in or out the battery and exciter respectively. A machine which may be used for converting multiphase alternating currents into undirectional currents, or *vice versa*, consists, for example, of three dynamos in combination with a three-phase alternating-current exciter, the armatures of which are all mounted adjustably on the same shaft, the dynamo armatures being set at angles to one another equal to the differences of phase between the fields. The field coils of the three dynamos are connected in three-phase relation with the armature of the exciter, while the three armatures are connected in series with one another and with the field of the exciter. This organisation exercises a regulating influence upon the unidirectional currents supplied to the mains. 10 claims.

20,346. "Improvements in the manufacture of incandescing electric lamps." W. L. Voelker. Dated October 10th, 1899. A bulb is partially divided to form two limbs with an intervening air space, the ends of the limbs being cylindrical. The bulb is left open at the top to receive a carbon or other filament attached to the leading-in wires, which are connected by a thin glass rod to facilitate handling. This rod may be broken off after the wires have been sealed in the ends of the limbs. The bulb is then nearly closed at the top, exhausted, and sealed. The main object is to prevent passage of current from one limb of the filament to the other across the exhausted space. The two limbs of the bulb are secured in an ordinary cylindrical cap. 3 claims.

20,387. "Improvements in or relating to the manufacture of cement, applicable for uniting porcelain, glass, metal, and other substances for the manufacture of electric glow lamps and for dental and other purposes." F. Sehr. Dated October 11th, 1899. A finely-ground powder, prepared from waste fragments of fully burnt hard porcelain and of half burnt porcelain, together with feldspar, is made into a paste with water-glass. The resulting cement is applicable for cementing porcelain, glass, &c., and in some cases for cementing these substances to metal. It is also specially applicable as a substitute for plaster of Paris in the manufacture of electric glow-lamps, or it may be employed as a dental filling or cement. 3 claims.

20,388. "Improvements in transmitters for Morse alphabet and printing telegraphy." Dr. L. Cerebotani and C. Moradelli. Dated October 11th, 1899. Relates to transmitting apparatus for Morse or printing telegraph systems, whether for single, duplex, or multiplex working. A cylinder having zones of contacts representing the Morse code or the contacts for printing-telegraph signalling with a receiver such as described in Specification No. 10,040, A.D. 1899. The cylinder makes one revolution on the depression of a key. The depressed key brings a spring into contact with its zone on the cylinder, and at the same time releases the cylinder by its trip-lever; at the same time the key is held down by its latch engaging with the swing-frame. The frame is freed by the cam on the cylinder-shaft, after the signal is completed. In printing telegraphs, an additional reverse current is sent on the completion of each signal. In a modified form, the contacts are set on a fixed disc and a rotating brush is employed. In duplex, &c., signalling the cylinder is divided to send both + and − currents, and the brushes may also be mounted to move with the keys, or the keys may make contact with brushes continually rubbing on the cylinder. In duplex, &c., working, the relay described in Specification No. 14,191, A.D. 1899, may be employed. 4 claims.

20,390. "Improvements in apparatus for automatically connecting any two of a number of electric circuits branching from a central station." Dr. L. Cerebotani. Dated October 11th, 1899. Relates to means for connecting any two electric circuits through a central station, applicable for telegraphy, telephony, lighting, controlling mechanical operations, &c. The apparatus is too complicated for purposes of abridgment. 4 claims.

20,412. "Improvements in electric railways working on the surface contact system." R. Lundell. Dated October 11th, 1899. Electric railways and tramways on the surface contact system with electro-magnetic switches operated through electro-magnets on the vehicle. The circuit from the main conductor to the road contacts is completed by an electro-magnet which is excited by a current from a low potential conductor when the secondary switches are closed by the approach or passage of the magnetised collector shoe. In one form the switches are placed on each side of the road contacts, and are connected to the electro-magnets in parallel pairs, so as to excite the stud next in front and to maintain it excited as the vehicle passes. The collector shoe is magnetised by coils excited by a battery or other current on the vehicle, and the magnetic circuit on the vehicle is made through this shoe and the axles and wheels. In the road the magnetic circuit flows through the rails, tie-bars, and sheet-iron pieces adjacent to the switches. The road contacts consist of short lengths of T-rails supported in longitudinal troughs, which also contain the switch boxes, sheet-iron pieces and conductors, &c., the trough being filled in with non-conducting material. The switches consist of pivoted L-pieces in non-magnetic boxes. Three modifications are described, in which only single switches are used near each contact, and the magnetic circuit-closing pieces are prolonged and the circuits otherwise arranged to allow sufficient time limit for closing the forward main switch. 4 claims.

20,438. "Improvements in means for holding shades or globes for electric and other lights." J. Barker. Dated October 12th, 1899. Lamp shade and globe holders for electric and other lamps, comprise a ring, preferably split, having spring fingers which support the shade or globe when the ring is secured by its projections between the shoulders on a nut and holder. A cushioning ring of india-rubber or like material is provided to minimise the risk of fracture to the shade or globe. 2 claims.

20,471. "Improvements in or relating to electric batteries." A. J. Boult. (P. Delafor.) Dated October 12th, 1899. Relates to a dry battery of the Leclanche type, in which the zinc is provided with holes on both of its long sides. The electrolyte is a paste made of equal parts of salammoniac, zinc chloride and felt dust, mixed with gelatine or the like, and the cell is filled with this paste. 4 claims.

20,480. "Improvements in electric arc lamps." C. Curwen. Dated October 12th, 1899. A portable enclosed arc lamp is provided with one or more pairs of carbons, and means for striking the arcs by hand, particularly for use in photographic printing. The pairs of carbons may be all in one globe or in separate globes arranged in line, or triangularly about the central pillar. In one forms springs in sockets on arms of the pillar support holders for the lower carbons and the globes, covers on these bearing against the upper arms of the pillar. The upper carbons are placed in spring holders in tubes which carry ordinary clutches, and are carried by a sleeve movable vertically by cams and a handle supported on the pillar. In another form carbons are movable by screws. 1 claim.

20,486. "Improvements in electric distribution switch and fuse boards." A. Jaray. Dated October 12th, 1899. Switches and cut-outs for use on distribution boards. Each board has two rows of holes, which have metal bushings sunk below the surface, so that the hand cannot touch them. The simple fuses consist of wires fitting in deep grooves in insulating handles, and connecting the plug terminals. In the switches the fuse is connected to one of the plugs and to one of the contacts, the other contact being connected to the other plug. 2 claims.